# PBY -5A C-FUAW
# AMENDMENT CHECK SHEET

The under mentioned amendments promulgated for this publication have been entered as indicated below

Amendment List

| Number | Date | Amendment Made By | Date |
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PACIFIC FLYING BOATS LTD.

# PILOTS

# PBY OPERATING HANDBOOK

# CONSOLIDATED PBY-5A / 285\ACF

This Handbook is the Property of: ______________________________________________ No. _______ of ______

## FORWARD

**The Purpose** of this handbook is to present a basis for the instruction of uniform Flying Boat handling techniques with a particular reference to the Canso aircraft. This handbook describes briefly the principal operating features of the PBY-5A Canso Airplane, with which the flight personnel are concerned. As in many of the large airplanes of the advance type, the duties of operating the PBY-5A Canso are divided between the Flying Pilot and the First Officer. With this division of duties, it becomes essential for the Flying Pilot and First Officer to coordinate their respective duties at all times for the safe and economical operation of the craft.

The limitations of performance and the operation of the plane must be fully understood be the entire crew as well as the Flying Pilot and the First Officer.

**The Scope** of this handbook is brief, but covers all the features of the plane necessary for its efficient operation. Details of the equipment and mechanisms of the airplane are covered by other Manuals / Handbooks placed aboard the airplane or at the operations base. Specific reference should be made to the Erection and Maintenance Manual as well as to the other Manuals / Hand Books for airplane equipment.

This handbook does not supersede specific technical publications, but rather this handbook is meant to compliment them.

# INTRODUCTION

Since the PBY-5A Canso of Pacific Flying Boats Ltd. has been greatly modified and from time to time continues to be modified, it follows that instrumentation and installation of ancillary equipment are not always the same in any two aircraft. While this non-standardization is regrettable, and in some cases, constitutes a minor annoyance, it in no way absolves the pilot from carrying out a complete and thorough check of each individual aircraft systems to ensure familiarity with the arrangement of switches, instruments and all other gauges and controls transferred from the *Flight Engineers Station or added to monitor new equipment.

The information contained in the chapters within this PBY-5A Canso handbook should be applied at all times while operating Pacific Flying Boats Ltd. aircraft. The check lists and reference charts are included to assist the flight crew in the interest of maximum safety and control.

The methods and techniques presented in this manual are not necessarily the only, or even the best ones, but they are safe and effective having been evolved over many years' experience. It is recommended that the novice learn and become proficient in these before experimenting in new methods.

Taking off and alighting on water involves coming in contact with it or travelling along its surface, at speeds ranging from zero to eighty knots. It should be kept in mind that water travelling at high speeds is used to strip bark from huge logs and to cut into the sides of mountains, removing tones of earth and rock during mining operations. This same water pressure can strip the skin from the hull of a Canso in an instant, if given the opportunity.

Therefore, an elementary knowledge of the basic laws of physics and mechanics is not only helpful, but essential in understanding the principles of water flying.

## THE CONSOLIDATED VULTEE - PBY-5A

The PBY is much larger than just a vintage flying boat, its history or, that it is one of the legendary iconic aircraft of WWII.

It is today, an “Experience!” A rare live opportunity to let you envision what flying was back in the day. Back, when an air flight was an adventure beyond compare and possibly a once in a lifetime event.

“The stuff legends are made of”

Reuben Fleet, founder of Consolidated Aircraft Industries and his chief engineer Isaac Laddon set tradition aside and reinvented the flying boat. An aircraft, born of necessity in 1935 the PBY was the new kid on the block. Her design was a revolutionary marvel in water boat concept and a marked departure from the bi-wing design of the day.

With the latest technology, she was the most advanced amphibious flying boat destine to become the workhorse of the RCAF and numerous allied countries in humanitarian and combat operational environments around the world during WWII that set her in a class of her own.

A robust multipurpose flying boat the PBY worked primarily from water bases providing anti-submarine support for convoys as well as Coastal Surveillance and Search and Rescue.

To those who flew her she is slow and ungainly with all the character, traits, and charm of a villain, a vixen, and a hero with all the curves in just the right places.

Her legacy as a feared aerial warrior and the saviour of thousands of downed pilots and stranded sailors earned her respect from the hearts of those who flew and knew her best.

Like her crew, she fought the long hard battles and earned her spot within the elite group of famous aerial warriors like the RCAF Lancaster bomber and Supermarine Spitfire, the USAF P–51 Mustang and B–29 flying fortress and is the subject of ‘Hanger Talk’ the world over.

A testament to the rugged character of the PBY and the men who flew her from 1936 until today:

***“When the PBY first flew, its fighter aircraft contemporaries were biplanes. It is a tribute to the PBY that it is still flying today in the age of supersonic jet fighters and space exploration” Canso Investment Ltd.***

# INDEX

# TABLE OF CONTENTS

CHAPTER 1

## DESIGN CHARACTERISTICS

# TABLE OF CONTENTS

CHAPTER 1 (continued)



CHAPTER 2

## OPERATING LIMITATIONS

## TABLE OF CONTENTS

CHAPTER 2 (CONTINUED)



CHAPTER 3

### PBY-5A PERFORMANCE LIMITATIONS



CHAPTER 4

### WEIGHT LIMITATIONS



CHAPTER 5

### FLIGHT OPERATIONS



APPENDIX



SUPPLEMENT

## CANADIAN CONSOLIDATED
## PBY-5 and 5-A

DESIGN Drawing

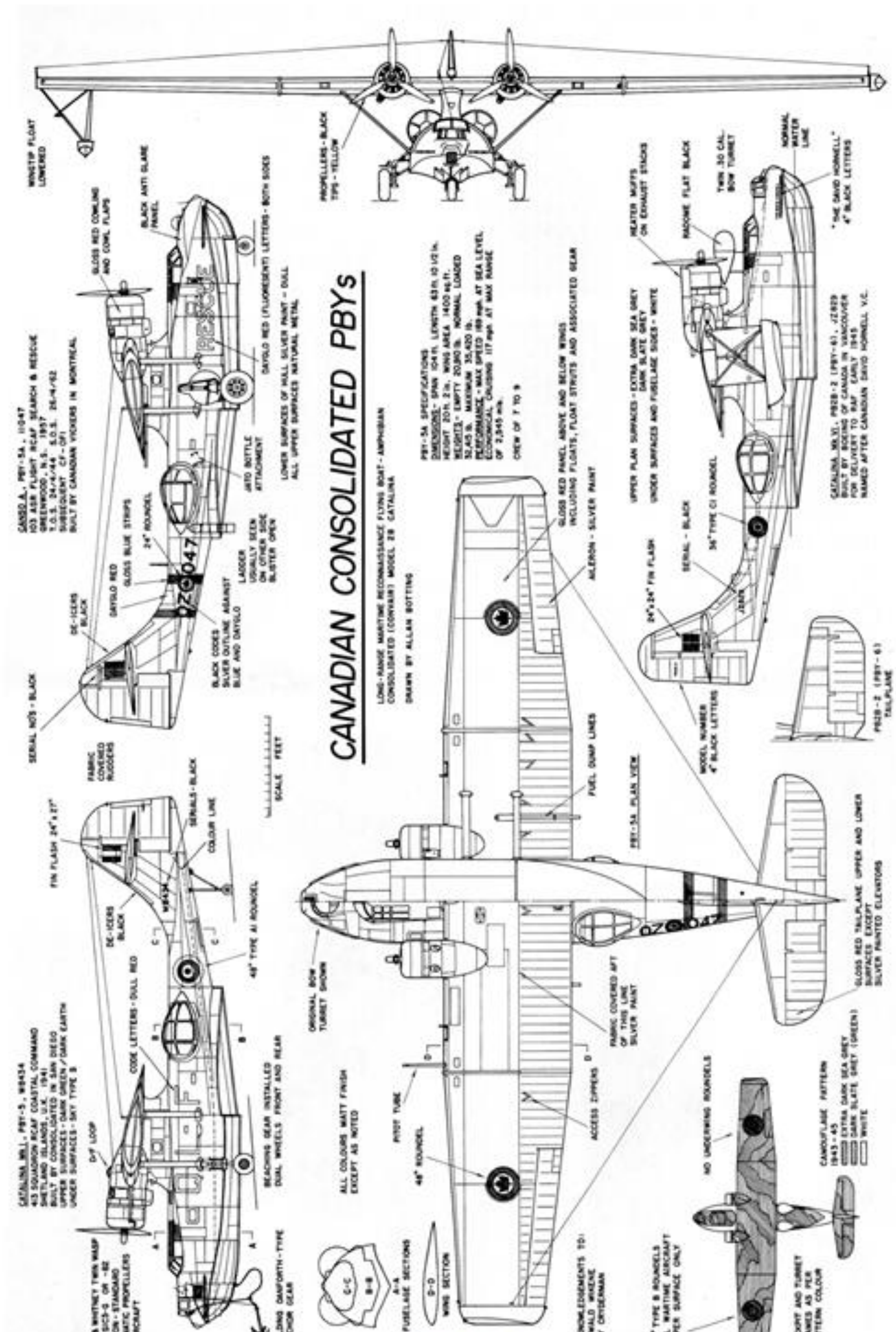



Figure 1

Drawing by: Al Botting

Fig 1

# DESCRIPTION

**General** - The Consolidated Vultee Aircraft Corporation (CVAC) Model PBY-5A is, with the exception of the fabric covered ailerons and wing trailing edges, are an all metal except, two engine semi cantilever monoplane wing amphibian, with a two step flying boat hull, equipped with retractable tricycle type landing gear and was utilized by the military services during World War II as a patrol bomber. The general arrangement and performance characteristics of the aircraft made it suitable for use in the commercial field, particularly in operations of an amphibious nature.
To provide eligibility for commercial transport use, various mandatory modifications were specified by the C.A.A. These modifications are published in the C.A.A. "Aircraft Listing", Pages 52 - 56, and are designated as specification 2-548, for the PBY5A, and as specification TC-785 for the Model 28-5ACF. Copies of these specifications will be found on the following pages:

**SPEC. 2-548** - details the modifications to be carried out on the military model of the PBY-5A to provide eligibility for commercial cargo carrying operations, in accordance with CAR 4A.

**SPEC. TC-785** - details the modifications which are necessary to convert the Model PBY-5A to a Model 28-5ACF. Fundamentally, the Model 28-5ACF is a Navy CVAC Model PBY-5A modified in accordance with CAR 3 to be eligible for passenger carrying operations.

**DOT Type Approval –** For operations conducted entirely within Canada, the Department of Transport has permitted certain deviations from the C.A.A Specifications. Basically, these deviations concern increases in the allowable take-off weights and the possible utilization of model PBY-5A as a passenger-carrying aircraft. Refer to Chapter 2, paragraph’s. 2.1 and 2.11 for information regarding these items.

**Flight Engineers Station** – Any reference in this manual to Pacific Flying Boats Ltd. PBY-5A C-FUAW Flight Engineers station including the associated flight engine instruments, cowl flaps, mixtures and engine fire extinguisher controls previously located in the superstructure/pylon have been moved to the cockpit as the Flight Engineers position in the superstructure has been eliminated.

# DESIGN CHARACTERISTICS

## - C.A.A. SPECIFICATION 2-548



CONSOLIDATED-VULTEE PBY-5 (Army OA-10) AND PBY-5A (Army OA-10A); 2-548

I - SPECIFICATIONS PERTINENT TO ALL MODELS:

| | |
|---|---|
| Cert. basis | Airworthiness Certificate only (CAR 04a) |

II - Deleted - December 21, 1956
Single aircraft Model 28-4 no longer available for civil certification.

III - Models PBY-5 (Army OA-10), & PCFBM, and PBY-5A (Army OA-10A), & PCAMX

| | |
|---|---|
| Engines | 2 P&W Twin Wasps S1C3-G or R-1830-92; with spline coupled type 16:9 reduction gear and one 3-1/2 dynamic damper. |
| Fuel (See NOTE 8) | 91 or 100 grade aviation gas. |
| Engine limits | Maximum continuous, (S.L.) 41.5 in.Hg., 2550 rpm (1050 hp) (7500 ft.) 39.5 in.Hg., 2550 rpm (1050 hp) |
| (See NOTE 8) | Takeoff (two minutes), 48.0 in.Hg., 2700 rpm (1200 hp); or 47.0 in.Hg., 2750 rpm (1200 hp) |
| Propellers | Ham. Std. hubs 23E50, blades 6153-12. For interchangeable blade models see Prop. Spec. No. 603 (NOTE 6). Dia.: Max. 12'3/8", min. allowable for repairs 11'9-1/4". No further reduction permitted. Low pitch setting: 17° at 42" sta. See NOTE 2(b) for required placard. |
| Airspeed limits (T.I.A.S.) (See NOTE 4) | Level flight or climb 170 mph (148 knots) Glide or dive 199 mph (173 knots) |
| C.G. range | (+242.2)(+22.9% MAC) to (+251.5)(28.5% MAC) |
| Datum | 3" aft of bow |
| MAC | 165.3 in. L.E. MAC Sta. 204.4 |
| Leveling means | Longitudinal inclinometer at Flight Eng. station (right side) and deck line. |
| Max. weight | 27,000 lbs. (Takeoff & landing) (See NOTE 3) |
| No. pass. | None. Certificated for cargo operation only. Occupancy of aircraft limited to personnel essential to flight. |
| Baggage | Max. capacity of compts.: Sta. 2-4, 3740 lbs.; Sta. 4-5, 2810 lbs. (PBY-5), 936 lbs. (PBY-5A); Sta. 5-6, 4100 lbs; Sta. 6-7, 3240 lbs. |
| Fuel capacity | 1750 gals. (2 tanks in CS at 875 gals.) |
| Oil capacity | 110 gals. (2 tanks, one in each nacelle at 55 gals.) |
| Control surface movements | Rudder right 23°, left 23°; elevator up 29-3/4°, down 19°; aileron up 21°, down 22°; rudder trim tab right 13½°, left 12°; elevator trim tab up 5-3/4°, down 10¼°; aileron trim tab up 16°, down 16°. |
| Serial Nos. eligible | PBY-5: 91, 92, 93, 94, 163 and all Army and Navy serial numbers. PBY-5A: 87, 110, 111 and all Army and Navy serial numbers. |

EQUIPMENT: Equipment and weight thereof as noted in approved copy of pertinent report and loading schedule which must accompany certificate and form part thereof.

NOTE 1. Eligible for export to all countries subject to the provisions of MOP 2-4.

NOTE 2. The following placards shall be placed on the instrument panel in full view of the pilot: (a) "This airplane shall be operated in accordance with the CAA Approved Operating Manual for Consolidated PBY-5 (PBY-5A) which shall be carried in the pilot's compartment at all times."
(b) "Avoid continuous operation between 1700 and 1850 rpm."

NOTE 3. Max. weight may be increased 162 lbs. when complete de-icer is installed.

NOTE 4. The airspeed indicator installation error must not exceed +4.5 knots at a true indicated airspeed of 148 knots.

NOTE 5. Current weight and balance report including list of equipment included in certificated weight empty, and loading instructions when necessary, must be in each aircraft at the time of original certification and at all times thereafter, except in the case of air carrier operators having an approved weight control system. Prior to original certification, each airplane must be weighed to determine its weight and balance, unless a satisfactory Army or Navy weight and balance report is available.

NOTE 6. Prior to certification as a civil aircraft the following must be accomplished:

(a) Each airplane must satisfactorily pass an inspection for conformity, possible hidden damage, and for workmanship and materials used in making any repairs and/or alterations.
(b) Install also outside air temperature indicator, covers for cables and conduits in fwd. cargo compt., stowage for bulkhead No. 6 water-tight door, 2 sea anchors with stowage provisions, and life raft with stowage provisions.
(c) The firewall either must be completely replaced by, or covered or backed up by, one of the following materials:
    (1) Stainless steel - .015 in. thick.
    (2) Nickel-chromium-iron-alloy - .015 in. thick.
    (3) Low carbon steel - .018 in. thick (aluminum coated or otherwise protected against corrosion).
    (4) Monel metal - .018 in. thick.
    (5) Terneplate - .018 in. thick.
(d) Means must be installed to provide, without continuous manual operation, vision through the windshield adequate for executing takeoffs and landings on water with spray striking the windshield.
(e) Guards must be installed to prevent the inadvertent operation of switches on control column and on forward side of bulkhead aft of pilot's compartment.
(f) The supports for the servo control fluid lines forward of the servo must be replaced with supports having adequate strength and rigidity.
(g) Positive means of communication between the pilot, copilot, and flying engineer must be installed.
(h) Fuel dump valves must be removed or made positively inoperative.
(i) Instruments must be marked for approved operation limits.
(j) Airplane must be modified in accordance with either
    (1) Install a carburetor alcohol de-icing sys. with a capacity of not less than 5 gal. per engine. The capacity of the alcohol pumps should be sufficient to provide a flow of 10 gal. per hr. to both engines simultaneously; or
    (2) Modify the carburetor air preheat system to provide a heat rise of 100°F when operating at 75% power at an outside air temperature of 30°F.
(l) All cargo compts. must be placarded for permissible loads specified in C.A.A. Approved Operating Manual.
(m) Identification plate must be marked to indicate date of conversion to certificated status.
(n) All fuel tank filler caps or adjacent surface must be marked to indicate the min. oct. fuel and the tank capacity.
(o) The oil tank filler caps must be marked "Oil" and indicate the tank capacity.
(p) Approval number "5E-4" should be added to R-1830-92 engine identification plates in lieu of Type Certificate No.
(q) If an exhaust heat type wing and tail de-icer system is installed, this system must be inspected giving special attention to its engine section and to the combustion heater in the tail of the airplane.
(r) The airplane heating system must be inspected.
(s) The carbon monoxide concentration in the pilot and crew compts. must be checked to ascertain that it does not exceed one part in 20,000 (or 0.005%).
(t) All circuit protectors must be made accessible in flight.
(u) The A.P.L. fuel unit drain outlets must be moved to a position remote from the auxiliary power plant exhaust outlet.
(v) Any G-9 or equivalent 400 gal. per hr. engine-driven fuel pumps must be installed.
(w) All armament, including rear gun blisters, must be removed. Front gun turret may be retained on the airplane but revolving mechanism must be removed or rendered inoperative, and the openings between the nose and the turret must be faired over.

NOTE 7. The following alterations are satisfactory and should be handled in the usual manner on Alteration and Repair Forms:
(1) Install cargo platforms and tie-down rings. See CONVAC Dwgs. 2877100 (1 and 2), 2877200 (1 and 2), 2877300 (1 and 2), 2877400, and 2877501.
(2) Install large water-tight door for, and enlarge cut-out in, bulkhead No. 6. See CONVAC Dwgs. 2877502 and 2815360.
(3) Install hull cargo door. See CONVAC Dwg. 2815223-A.

NOTE 8. 100 min. grade fuel must be used unless the carburetors have been suitably modified for operation with 91 min. grade fuel.

# DESIGN CHARACTERISTICS

## – C.A.A. SPECIFICATION TC-785



**CONSOLIDATED-VULTEE 28-5ACF, 25 PCAAM} TC 785**

| | |
|---|---|
| Engines | 2 P&W R-1830-92 (S1C3G); or 2 P&W R-1830-75(2SC9G) installed per NOTE 10. |
| Fuel (See NOTE 3) | 91/96 min. grade aviation gas. *HP |
| Engine limits | R-1830-92: |

| | HP | RPM | In.Hg. | Alt. |
|---|---|---|---|---|
| R-1830-92: | | | | |
| Max. continuous | 1050 | 2550 | 41.5 | S.L. |
| Max. continuous | 1050 | 2550 | 39.5 | 7500 |
| Takeoff (2 min.) | 1200 | 2700 | 48.0 | S.L. |
| Takeoff (2 min.) | 1200 | 2750 | 47.0 | S.L. |
| R-1830-75: | | | | |
| Max. continuous | 1100 | 2600 | 43.5 | S.L. |
| Max. continuous | 1100 | 2600 | 42.7 | 7300 |
| Takeoff (2 min.) | 1200 | 2700 | 47.0 | S.L. |
| Takeoff (2 min.) | 1200 | 2700 | 46.0 | 6500 |

*(Straight line manifold pressure variation with altitude shown)

| | | |
|---|---|---|
| Airspeed limits (T.I.A.S.) (See NOTE 10 for $V_{ne}$ with under wing boats) | Maneuvering | 122 mph (106 knots) |
| | Cruising | 158 mph (137 knots) |
| | Never exceed | 199 mph (173 knots) |
| | Landing gear oper. | 140 mph (122 knots) |
| | Landing gear ext. | 160 mph (139 knots) |

| | |
|---|---|
| C.G. range (Gear Down) | (+242.2)(22.9%MAC) to (+251.0)(28.2%MAC) Effect of L.G. retraction +12485 in.lbs. |
| Datum | 302 in. fwd. of step (bulkhead No. 5) |
| MAC | 165.3 in., L.E. of MAC Sta. (+204.4) |
| Leveling means | Leveling lugs in tail between bulkheads 7 & 8 (+500 & 550), or longitudinal inclinometer at Flight Engineer's station (right side at deck line). |
| Weight limits | Takeoff & landing 28,000 lbs. (See NOTES 5A-2, 6, 9 & 10 for further limits). |
| Max. passengers | 22 (location variable)(See NOTES 5A-12 and 5A-13) |
| Min. crew | 2 (+110) or 2 (+110)& 1(+260)(See Note 5B-5) |
| Max. baggage | (See NOTE 5A-11) |
| Fuel capacity (See NOTES 4 & 7) | Total capacity 1750 gals. (2 tanks 875 gals.ea.). Max. allowable capacity variable (See NOTE 7)(+267) |
| Oil capacity (See NOTE 4) | 110 gals. (2 tanks, 1 in each nacelle, 55 gals. ea.) 825 lbs. (+208) |

| | | | |
|---|---|---|---|
| Control surface movements | Elevator | up 30° | down 20° |
| | Aileron | up 21° | down 19-3/4° |
| | Rudder | right 17° | left 17° |
| | Elevator tab | up 5° | down 5° |
| | Rudder tab | right 15° | left 20° |

| | |
|---|---|
| Serial Nos. eligible | 9747, 9749, 9791, & all Army, Navy & RCAF PBY-5A aircraft (See NOTE 5) |
| Required equipment | Items 1(a), 2(a), 3(a), 101, 102, 103, 104, 105, 106, 201(a), 202(a) or (b) (See NOTE 6), 203, 204; 301, 302, 401, 402, 403, 404, 405, 501, 601. |

**Specifications Pertinent to All Models**

Certification basis Type Cert. No. 785 (Comb. CAR 3 & 4a)

Export eligibility Eligible for export to all countries subject to the provisions of MOP 2-4.

Equipment:

Propellers and Propeller accessories

1\. (a) Propellers, Ham. Std. hubs 23E50, blades 6353-12. For interchangeable blade models see Prop. Spec. No. 603 (NOTE 6) — 796 lbs. (+135)
Dia.: Max. 12'3/8", min. allowable for repairs 11'9-1/4". No further reduction permitted.
Low pitch setting 18° at 42" sta.
See NOTE 2(d) for required placard.

2\. (a) 2 Propeller governors, Ham. Std. Model 4G11-60S or equivalent — 12 lbs. (+161)

3\. (a) 2 Propeller feathering pump installations, Pesco Type 1E-R280-34 or equivalent. — 47 lbs. (+198)

Consolidated-Vultee 28-5ACF, etc., (Continued)

Engines and Engines Accessories-Fuel and Oil System

101\. 2 Fuel Pumps, Type G-9 or equivalent — 6 lbs. (+181)
102\. 2 Oil Coolers, either Airesearch No. 2E-5050, No. 23-6232, or equiv. — 80 lbs. (+187)
103\. 2 Oil Temperature Regulator Valves, U.A.P. 2D-3058-4 or equivalent — 8 lbs. (+198)
104\. 2 Fuel Booster Pumps, Pesco 2 P-1600-CEE-1 or equivalent
105\. System Fuel and Oil (See NOTE 4)
(a) System fuel — 66 lbs. (+267)
(b) System oil — 112 lbs. (+206)
106\. Firewall Shut-Off Valves
(a) 2 Oil System Valves, General Controls LO8584 or equivalent
(b) 2 Fuel System Valves, Whittaker W7951, 1¼"D, or equivalent
(c) 2 Hydraulic System Valves, Whittaker W7950, 1¼"D., or equiv.

Landing Gear

201\. Two (2) main wheel-brake assys., 47", Type I
(a) Goodyear Model A475C
Wheel assy. #530144-1
Brake assy. #5106284
202\. (a) Two (2) main wheel 12-ply-rating tires, 47", SC, Type I, with regular tubes.
(b) Two (2) main wheel 10-ply-rating tires, 47", SC, Type I, with regular tubes. (See NOTE 6.)
203\. Nose wheel assy., 30", SC, Type I, Hayes 5950A(G-3-96)
204\. Nose wheel 8-ply-rating tire, 30", SC, Type I, with regular tube.

Electrical Equipment

301\. 2 Generators, Type P1 or equivalent — 89 lbs. (+191)
302\. 2 Batteries, AN 3152 or equivalent — 80 lbs. (+210)

Interior Equipment

401\. (a) FAA Approved Airplane Flight Manual. (Basic)
(b) FAA Approved Flight Manual, Southern California Aircraft Corp., Report No. R1007 dated June 25, 1951, when P&W R-1830-75 engines are installed.
402\. Indicator, carburetor air temperature, Lewis 7703 or equivalent
403\. Gage, hydraulic press. Hollaman AN-Q-118 or equivalent
404\. Indicator, cowl flap position, GE8DJ-12-PBC or equiv.
405\. Indicator, cylinder head temperature, AN 5536-2A or equivalent.

De-Icing Equipment

501\. 2 Carburetor alternate air installations, CVAC 2 875008 or equivalent

Miscellaneous, not listed above

601\. 2 Windshield wipers, Marquette DL2364 or equivalent

NOTE 1. Current Weight and balance report including list of equipment included in certificated weight empty, and loading instructions when necessary, must be in each aircraft at the time of original certification and at all times thereafter (except in the case of air carrier operators having an approved weight control system).

NOTE 2. The following placards must be installed in front of and in clear view of the pilot:
(a) "This airplane must be operated in compliance with the 'Approved Operating Limitations' of the Airplane Flight Manual."
(b) "No acrobatic maneuvers, including spins are approved."
(c) "Do not exceed engine temperature limits during water taxiing."
(d) "Avoid continuous operation between 1700 and 1850 rpm."

NOTE 3. The dash one setting on the Stromberg PD12H1 or H4 carburetors and standard 25 degree BTC ignition timing should be used on R-1830-92 engines to permit use of either 91 or 100 grade fuel.

NOTE 4. (a) "System fuel and oil" (Equipment Item 105) is that amount required to fill both system and the tanks up to the tank outlets to the engines when the airplane is in the level attitude. "System fuel and Oil" and all hydraulic fluid must be included in certificated weight empty. (See also NOTE 7)
(b) Fuel and Oil tank capacities do not include any "system fuel and oil."

NOTE 5. This airplane is fundamentally a Navy CVAC Model PBY-5A modified in accordance with the requirements of CAR 3 to be eligible for passenger-carrying operations. (Aircraft Spec. 2-548 above describes the modifications which are necessary to Model PBY-5A aircraft to provide eligibility for cargo-carrying operations only.) Listed as follows are the modifications which are necessary to convert the PBY-5A to a Model 28-5ACF:

A. Modifications required for aircraft previously certificated in accordance with Aircraft Specification 2-548:
(1) Mods. in accordance with the following CVAC Dwgs.:
28T 15000 3 Empennage Inst., Mod. (Details shown on Dwgs.28T15001 to 28T15020 & 28T15022 to 28T15024,incl.)
28D 5000 3D Cowl Inst., Engine

## DESIGN CHARACTERISTICS

- C.A.A SPECIFICATION TC-785 Continued Page 3 OF 4

28P 15012 Springs - Carburetor Air Scoop Rework (Installation of these springs shown on Dwg. 28P50087)

(2) To be eligible for max. weight of 28000 lbs. a slipper bow in accordance with CVAC Dwg. No. 28B 15001 B and pertinent detail dwgs. must be installed. The airplane is eligible for a max. weight of only 27000 lbs. with the original PBY-5A nose and turret installed, provided the turret revolving mechanism is removed or made inoperative and the openings between the nose and turret are faired over.

(3) The rear gun blisters must be removed and a satisfactory passenger door installed. The number of auxiliary exits required will be governed by CAR 3.387.
The navigator's escape hatch in the top of the cabin near bulkhead 3 will be considered as one auxiliary exit, provided it is properly placarded and a suitable ladder or other equivalent means of access is stowed adjacent to the hatch so as to readily permit easy egress through the hatch.
CVAC Dwgs. which cover approved entrance doors and auxiliary exits are:
28B5223 A, Door-Hull Cargo (one left, one right)
28B15000 Hull, Rework Assembly
28B15016A, Escape Hatch - Sta.6.4 R.H.
28B15017B, Main Entrance Hatch
28B15030A, Rework-Blister Compt. - Sta.6-7
See NOTE 9 with reference to waist blisters.

(4) At or near the firewalls, emergency shut-off valves (equipment items 106, a, b and c) must be incorporated in all lines carrying inflammable fluid into the engine compts. If these valves are located forward of the firewall, they and any other system components between the valves and the firewall must be fireproof or adequately protected by fireproof wrapping or stainless steel shrouds. The control installation shall be acceptable to the FAA rep. and the operating means shall be located convenient to the pilot and co-pilot or to the flight engineer, and shall be properly marked.

(5) The identification plate must be marked to show the designation as Model 28-5ACF and to indicate the date of conversion.

(6) Combustion heaters for tail de-icer or cabin heating, if installed, must be of type approved by the FAA. Their installation, fuel system, etc., must be thoroughly inspected to insure that no hazardous conditions may exist (see paragraph A-10, below).

(7) If an exhaust heat-type wing de-icer system is installed, the system must be thoroughly inspected for evidence of corrosion, deterioration or possible hazardous conditions, with particular attention given to the engine section.

(8) A stainless steel diaphragm must be installed between the power and accessory sections of each engine. All openings in these diaphragms shall be sealed with close-fitting fire resistant grommets, bushings or firewall-type fittings.

(9) If not previously accomplished, the firewall must be completed by downward extension to the nacelle skin.

(10) Unless installed in an otherwise approved manner, all equipment (such as auxiliary power plants, fuel-burning heaters, etc.) which create potential fire zones during flight must be isolated from the remainder of the airplane by means of fireproof material, or adequately protected by a fire detection and extinguishing system. In either case, suitable means must be provided to shut off the flow of inflammable fluids to this equipment.

(11) Cargo and baggage compt. flooring and floor beams and all new interior equipment installations must be substantiated for ultimate load factors of 6.5 (positive) and 1.7 (negative). The cargo and baggage compts. must be provided with adequate tie-down fittings and contain adequate placards to indicate the maximum approved capacities.
If the original flooring and floor support structure are retained, the following approved compt. capacities based upon uniformly distributed load and use of the airplane as a cargo carrier, may be used as a basis for determination of allowable compt. loads and placards:

| Compartment (hull stations) | Total Capacity (lbs.) | C.G. (Approx.) |
|---|---|---|
| 2-4 | 3740 | +172 |
| 4-5 | 936 | +266 |
| 5-6 | 4100 | +344 |
| 6-7 | 3240 | +422 |

Consolidated-Vultee 28-5ACF, etc., (Continued)

(12) Safety belt and passenger seat installations other than originally provided by the manufacturer must be shown to at least meet the strength requirements of CAR 4a.

(13) The bottom of the forward superstructure compt. (fwd. of the flight engineer's instrument panel) must be sealed to prevent any spilled fuel from entering the hull, and the compt. must be adequately drained and vented.

(14) The compt. containing the flight engineer's sta. must be placarded against smoking.

(15) All hose connections in the oil return line in each engine accessory section must be double clamped.

(16) Installation of provisions for more than 22 passengers is contingent upon incorporation of additional emergency exits complying with CAR 3.387.

(17) The pitot static head of the airspeed system must be modified by adding a ring to the head 15/32 in. fwd. of the center line of the static opening. This ring should be made of .063 music wire, should fit tightly on the head, and be attached to the head with silver solder.

(18) For operation of the airplane as an amphibian, it is necessary that the original PBY-5A (or their equivalent) water-tight doors be supplied for hull bulkhead Stations 2, 4, 6 and 7. These doors must not be closed during take-offs and landings but should either be hinged to, or positioned adjacent to, their respective bulkheads, so that they may be readily positioned in case of water emergency.

B. Aircraft not previously certificated in accordance with Aircraft Spec. 2-548 must comply with all the provisions of NOTE 5A, above, plus the following:

(1) Two sea anchors and life rafts as required by the operations which are authorized, with adequate stowage provisions for these items, must be provided.

(2) The firewall either must be completely replaced by, or covered, or backed up by one of the following materials:
(a) Stainless steel -.015 in. thick.
(b) Nickel-chromium-iron-alloy-.015 in. thick.
(c) Low carbon steel-.018 in. thick (Aluminum coated or otherwise protected against corrosion).
(d) Monel metal -.018 in. thick.
(e) Terneplate -.018 in. thick.

(3) Guards must be installed to prevent the inadvertent operation of switches on control column and on fwd. side of bulkhead aft of pilot's compartment.

(4) The supports for the servo control fluid lines fwd. of the servo must be replaced with supports having adequate strength and rigidity.

(5) Positive means of communication between the flight engineer, if utilized, and the pilot and co-pilot must be installed.

(6) Fuel dump valves must be removed or made positively inoperative.

(7) Instruments must be marked for approved operation limits.

(8) The carburetor air intake systems must be modified in either of the following manners:
(a) Install a carburetor alcohol de-icing system with a capacity of not less than 5 gal. per engine. The capacity of the alcohol pumps should be sufficient to provide a flow of 10 gal. per hr. to each engine simultaneously. (CVAC Dwg. 28 P 15000 or equivalent)
(b) Modify the carburetor air preheat system to provide a heat rise of 100° F when operating at 75% power at an outside air temperature of 30°F. (Equipment item 501 not adequate)

(9) All fuel tank filler caps or adjacent surface must be marked with the word "fuel", the min. fuel oct. rating, and the tank capacity.

(10) The oil tank filler caps must be marked with the word "oil" and the oil tank capacity.

(11) FAA approved number "5E-4" should be added to the military engine identification plates in lieu of the Type Certificate No.

(12) All electrical system circuit protectors must be made accessible in flight.

(13) The drain outlets for the A.E.L. strainer-wobble pump units must be moved to a position remote from the aux. power plant exhaust outlet, if the latter is installed.

NOTE 6. When equipment item 202(b) is installed, landplane operations are limited to a max. weight of 27000 lbs.

## DESIGN CHARACTERISTICS

- C.A.A. SPECIFICATIONS TD-785 Con't Page 4 OF 4

Consolidated-Vultee 28-5ACF, etc., (Continued)

NOTE 7. The total fuel tank capacity for this Model is 1750 gals. (10,500 lbs.), but the usual empty weight of these airplanes is such that this total cannot be utilized. The max. allowable capacity for each airplane should be determined in the following manner:

From the max. certificated weight, subtract the sum of airplane empty weight (as equipped), full oil, and min. crew weight (170 lbs.ea.). The difference is the max. allowable fuel in lbs.

The fuel tank filler necks (or adjacent surface) and the fuel quantity indicators should be placarded accordingly (see also NOTE 4) and pertinent notes added to the loading schedule, if utilized, and to the Airplane Operating Limitations.

NOTE 8. Prior to certification as a Model 28-5ACF, each aircraft must satisfactorily pass:

(a) An inspection for possible hidden damage, for workmanship and materials used in making any repairs and/or alterations, and for conformity with drawings describing all required changes (see NOTE 5).

(b) A check of flight characteristics when the FAA representative considers it necessary.

NOTE 9. Model 28-5ACF is approved with retention of waist blisters and a modified clipper bow at a maximum take-off and landing weight of 27,880 lbs. when modified per Southern California Aircraft Co., Ontario, California, Form ACA-337 dated December 27, 1948. Airplane Flight Manual must be revised in accordance with approved manual for aircraft N69043 owned by the Southern California Aircraft Corp., Ontario, California. When such blisters are retained, the fixed elevator trim tab, described in CVAC Dwg. No. 28T15024, must not be incorporated.

NOTE 10. Under wing boats may be installed in accordance with Southern California Corp., Ontario, California, Form ACA-337, dated June 6, 1950. P&W R-1830-75 engines may be installed in accordance with Southern California Corp., Form ACA-337, dated May 2, 1951. Item 401(b) is required with this installation.

When either or both of these installations are incorporated the following limitations apply:

| | P&W | P&W |
|---|---|---|
| Engine Installation | R-1830-92 | R-1830-75 |
| Take-off & Landing without boats under wing | 28,000 lbs. | 29,310 lbs. |
| Take-off & Landing with boats under wing | 26,800 lbs. | 28,030 lbs. |

When under wing boats are installed the never exceed speed must be reduced to 175 mph (152 knots).

DEPARTMENT OF TRANSPORT 24 Issue
AIR SERVICESConsolidated –Vultee
OTTAWA, CANADA PBY-C 28-5ACF

AIRCRAFT TYPE APPROVAL August 16, 1961

Manufacture: Consolidated-Vultee, Canadian Vickers, Boeing of Canada

I. Model PBY-5A Aircraft of this type shall comply with the terms listed in U.S. Civil Aeronautics Administration Aircraft Listing 2-548, Section III, except that for operations conducted entirely within Canada, the following deviations shall apply:

(a) Maximum weights (Note 1)

| | |
|---|---|
| Provisional take-off weight | 30,500 lb. (Note 2) |
| Landing weight | 27,000 lb. |

(b) Passengers are permitted provided adequate seats, safety belts, emergency exits and a suitable passenger door are installed. (Note 4).

(c) The waist gun blisters may be retained for non-passenger carrying operations. They may also be retained when passengers are carried provided a suitable passenger door and adequate emergency exits are installed. The original waist gun blister arrangement consisting of a fixed outer shield and a rotating inner shield is not acceptable as an entrance door or emergency exit for passengers.

(d) The provision of water-tight doors for bulkheads 4 and 6 is optional

II. Model 28-5ACF Aircraft of this type shall comply with the terms listed in U.S. Civil Aeronautics Administration Aircraft Listing TC 785, except that, for operations conducted entirely within Canada, the following deviations shall apply:

(a) Maximum weights (Note 1)

| | |
|---|---|
| Provisional take-off weight | 30,500 lb. (Note 2) |
| Landing weight | 28,000 lb. (Note 3 for further listing) |

(b) The provision of water-tight doors for bulkheads 4 and 6 is optional

AIRCRAFT TYPE APPROVAL 24 Issue 8

Pertinent to all Models

The following items of equipment have been approved for installation in the PBY-5A and 28-5ACF. These are additional to those listed in Aircraft Listings 2-548 and T C 785.

Propeller and Propeller Accessories

Propeller, Hamilton Standard 23E50/6477A-O (paddle blades)

Engine and Engine Accessories

JATO Installations

(a) Two Aero-Jet-General Corporation Model 15 KS-1000-A1 rocket engines installed in accordance with Aircraft Industries of Canada Limited drawing 28-56001E. Timmins Aviation Limited approved Flight Manual Supplement covering rocket engine operation is required equipment
when these engines are installed.

(b) Two Aero-Jet-General Corporation Model 15 KS-1000-A1 rocket engines installed in accordance with Aircraft Industries of Canada Limited drawing 231-59001. Bristol's Approved Flight Manual Supplement, Engineering Report 2854, covering rocket engine operation is required equipment when these engines are installed. Installation may be made only if aircraft has been previously fitted in accordance with the Royal Canadian Air Force Engineering Order 05-60A-ep/46 dated 26 November, 1953, or equivalent.

Landing Gear

Skis: Aircraft Industries of Canada Limited
Main ski installation to drawing AI-PBY-087 sheet 1
Nose ski installation to drawing AI-PBY-087 sheet 2

Miscellaneous Installations

External Loads: Carriage of the following external loads is approved when operations are conducted in accordance with Information Circular 0/36/62. Items (a) and (b) shall not be carried simultaneously.

(a) Two modulo panels, one on each side of the aircraft, attached to the underside of the wing, in accordance with Queen Charlotte Airlines' Engineering Notice No. C-1000, page 2 through 13.

Maximum overall dimensions of each panel – 16 ft. x 4 ft.2 in. x 11 ins.
Maximum weight of each panel -575 lb.
Maximum aircraft take-off weight - 28,000 lb.

Miscellaneous Installations (cont'd)

(b) Two timbers, one on each side of the hull, lashed to timber carrying brackets, installed in accordance with Queen Charlotte Airlines' Engineering Notice No. C-1000, pages 14 and 15

Maximum overall dimensions of each timber 6 ins. x 16 ins. x 20 ft. long
Maximum weight of each timber - 500 lb.
Maximum landing weight - 28,000 lb.

602 Water Dropping Installations

(a) Installation of water tanks in aircraft hull, dump doors, probe and operating mechanism to production drawings listed in Field Aviation Company Report No. 4562A

Maximum take-off weight - 30,500 lb.
Maximum landing weight - 27,000 lb.
Water capacity - 800 Imp. gal.

Aircraft to be operated in accordance with Flight Manual Supplement given Field Aviation Company Report 4562 Appendix 2See Note 5 for restrictions on carrying passengers

(b) Two externally mounted water tanks of 325 Imp. gal capacity each installed in accordance with Aircraft Industries of Canada Ltd. drawings:

AI-C-8130 with scoops attached to tanks
AI-C-81223 with scoops attached to hull

Aircraft to be operated in accordance with Flight Manual Supplement contained in Aircraft Industries of Canada Ltd.Report AI-TR-320B for installation with scoops attached to tanks and Report AI-TR-329A with scoops attached to hull.
See Note 6 for restrictions on carrying passengers

Note 1. No additional allowance for de-icers is permitted when operating at these weights.

Note 2. Take-off weight is limited to maximum landing weights in waves higher than 2 feet

Note 3. (a) Seaplane landing weight is limited to 27,000 lb., unless clipper bow is installed (ref. TC 785, Note 6).

(b) Landing weight on wheels is limited to 27,000 lb. when 10 ply rating tires are used (ref. TC 785, Note 6).

Note 4. When passenger seats are installed in the Model PBY-5A, the number ofemergency exits
required is as follows:

| ☆ Number of persons for which seats are provided | Minimum number of exits required |
|---|---|
| 5 or less | 1 |
| 6 to 15 | 2 |
| 16 to 22 | 3 |

☆ Includes crew members carried aft of bulkhead 2.

When more than one exit is required the second exit shall not be located on the same side of the cabin as the main entrance door. The original navigators' escape hatch in the roof between bulkheads 2 and 4 is acceptable as a third exit only.

Bulkhead doors through which passengers would pass in making a normal exit shall be open during take-off and landing.

Note 5. During water dropping operations the number of persons on board is limited to the necessary crew. Passengers and cargo may be carried at other times with the same limits as for the unmodified aircraft provided the water master switch is "off", water hydraulic isolation valve is "off", the stiff leg safety bracket and the probe safety bracket are installed. This applies to item
602 (a).

Note 6. The following restrictions apply when water tanks, item 602(b), are installed:

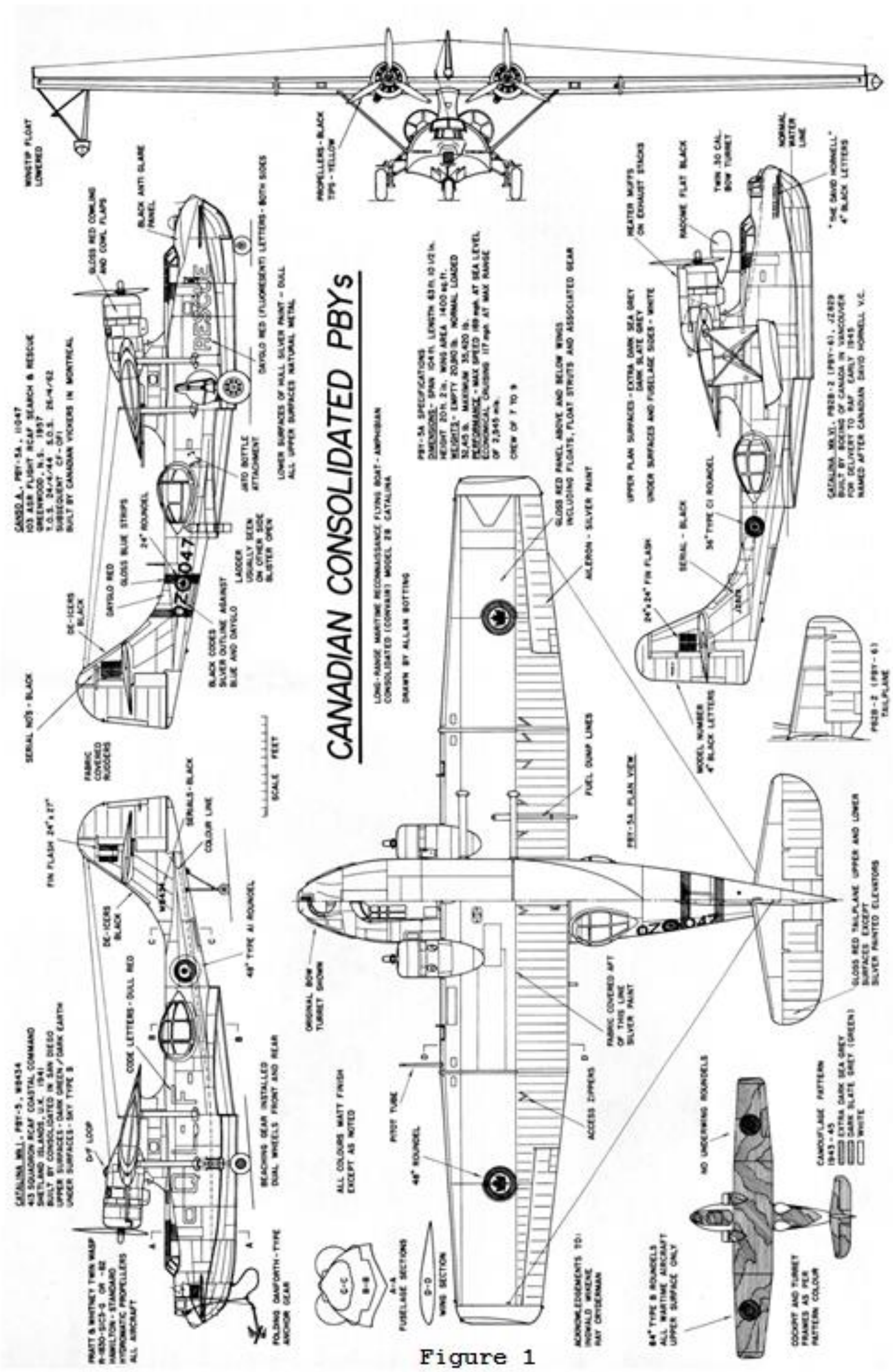
(a) the number of persons on board is limited to the essential flight crew and observer:

(b) the aircraft may not be used for any commercial purpose other than fire-fighting or ferry, except that while engaged in fire- fighting it may be used to transport men and equipment connected with this operation provided the water tanks are empty.

(H.S. ROSS),
Chief Aeronautical Engineer
Department of Transport

**CANADIAN CONSOLIDATED**
**PBY-5 and 5-A**

DESIGN Drawing



Drawing by: Al Botting

Fig 1

# CANADIAN CONSOLIDATED
# PBY-5 and 5-A

# CHAPTER 1

# DESIGN CHARACTERISTICS

# DESIGN CHARACTERISTICS

## 1.0 PBY-5A Description and General Dimensions and Specifications

This airplane is an all metal, two engine amphibian, with a flying boat hull 62 ft, 10 inches long, equipped with retractable tricycle type landing gear and is powered by two Pratt and Whitney R-1830-92 engines. The wing is mounted on a superstructure built up from the hull.

### a. Overall Height and Width

| | | |
|---|---|---|
| (1) | Span | 104 ft |
| (2) | Length (over all) | 63 ft 10-7/16 in |
| (3) | Height (over wing) | 13 ft 5-1/2 in |
| (4) | Height (on landing gear with propeller blade vertical at top) | 21 ft 1 in |
| (5) | Height over propellers on beaching gear | 17 ft 11 in |

### b. Wings

| | | |
|---|---|---|
| (1) | Airfoil Sections (curve identification) | NACA 21 |
| (2) | Chord at root | 15 ft |
| (3) | Chord at tip | 10 ft |
| (4) | Incidence | + 6° |
| (5) | Dihedral (outer panel taper only) | 2° 20' |
| (6) | Sweepback at outer panel | 2° 58' |

### c. Stabilizer

| | | |
|---|---|---|
| (1) | Span | 30 ft 6 in |
| (2) | Maximum chord | 8 ft 4 in |
| (3) | Incidence | + 4° |

### d. Hull

| | | |
|---|---|---|
| (1) | Width (Maximum) | 10 ft 1 ½ in |
| (2) | Height(Maximum) | 8 ft 4 in |
| (3) | Length | 63 ft 10 7/16 in |

### e. Area

| | | |
|---|---|---|
| (1) | Wings (Less ailerons) | 1300 sq. ft |
| (2) | Ailerons (total) | 100sq. ft |
| (3) | Stabilizers (Including 3.5 sq. ft Hull-Fin area and 18.4 sq.ft of contained elevator balance) | 138.2 sq. ft |
| (4) | Elevators, two, including tabs | 66.6 sq. ft |
| (5) | Elevator Trim Tabs (total) | 3.9 sq. ft |
| (6) | Fin | 3.5 sq. ft |
| (7) | Rudder (including tabs) | 40.4 sq. ft |
| (8) | Rudder Trim Tab | 2.6 sq. ft |

## DESIGN CHARACTERISTICS

f. **Control Surfaces Movement**

**PBY-5A28-5ACF**

| | | | |
|---|---|---|---|
| (1) | Rudder – Right .......... | 23.00° | 17.00° |
| | Rudder – Left .......... | 23.00° | 17.00° |
| (2) | Elevator – Up .......... | 29.75° | 30.00° |
| | Elevator – Down .......... | 19.00° | 20.00° |
| (3) | Aileron – Up .......... | 21.00° | 21.00° |
| | Aileron – Down .......... | 22.00° | 19.75° |
| (4) | Rudder Trim Tab – Right .......... | 13.50° | 15.00° |
| | Rudder Trim Tab – Left .......... | 12.00° | 20.00° |
| (5) | Elevator Trim Tab – Up .......... | 5.75° | 5.00° |
| | Elevator trim Tab – Down .......... | 10.25° | 5.00° |
| (6) | Aileron Trim Tab – Up .......... | 16.00° | |
| | Aileron Trim Tab – Down .......... | 16.00° | |

g. **Wheel Type Landing Gear**

(1) Type .......... Tricycle Hydraulically Retract

(2) Tread .......... 16 feet 7 inches (centre of tire to centre of tire)

h. **Wingtip Floats**

(1) Type .......... Electrically and / or Manually operated

(2) Tread (from keel to keel) .......... 89 feet 4 inches

(3) Length of Float .......... 10 feet 3-7/8 inches

# DESIGN CHARACTERISTICS

**Dimensions & Measurements**

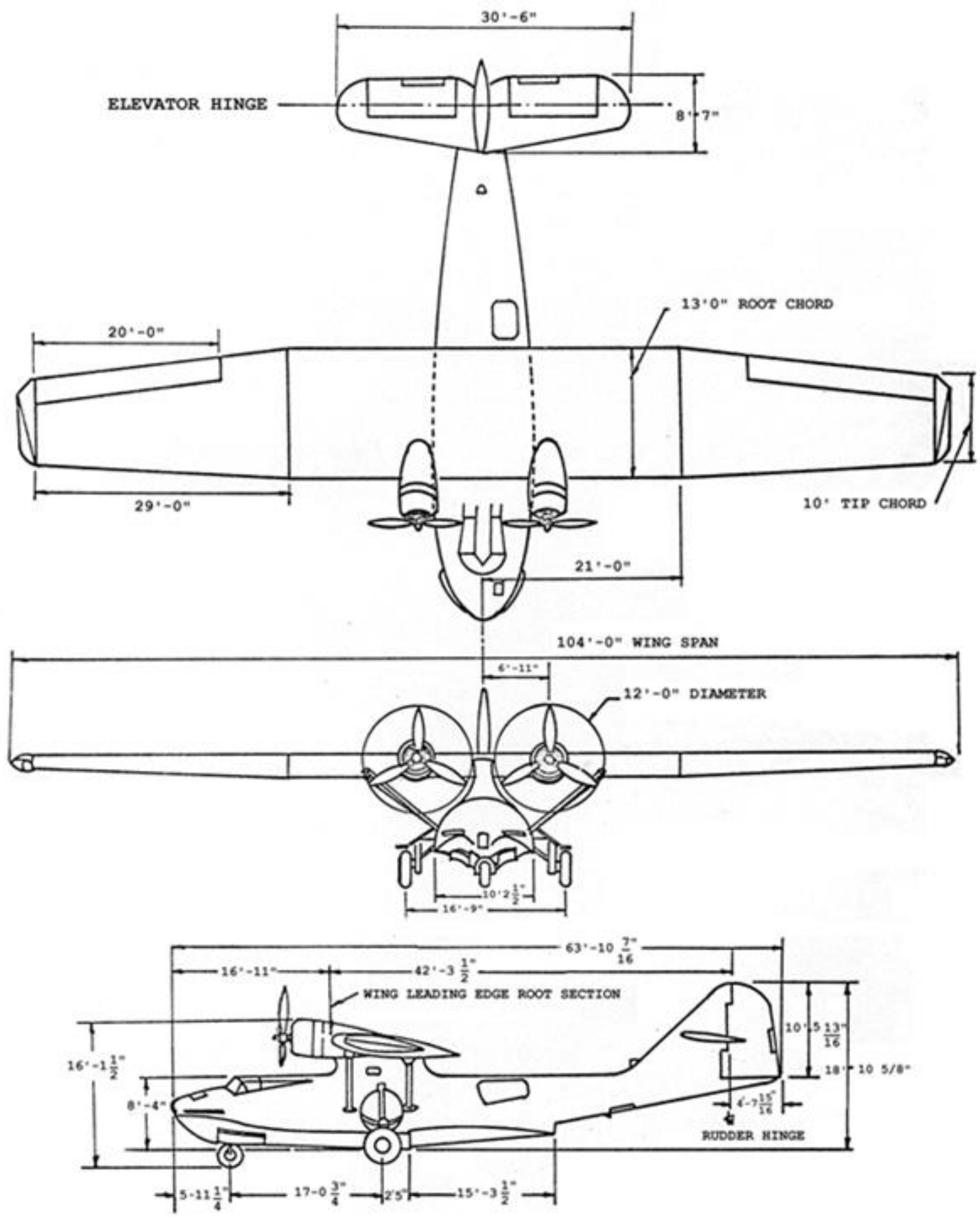
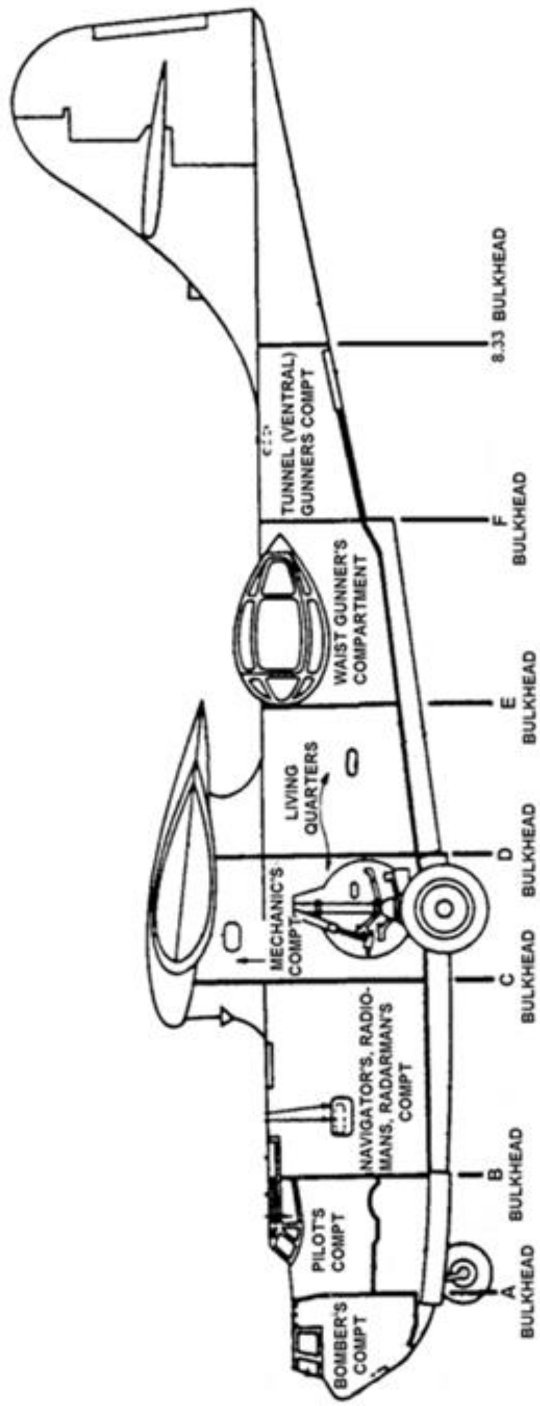



Figure 2 DESIGN IMAGE

Fig 2

## DESIGN CHARACTERISTICS




**PBY - 5A COMPARTMENTS**

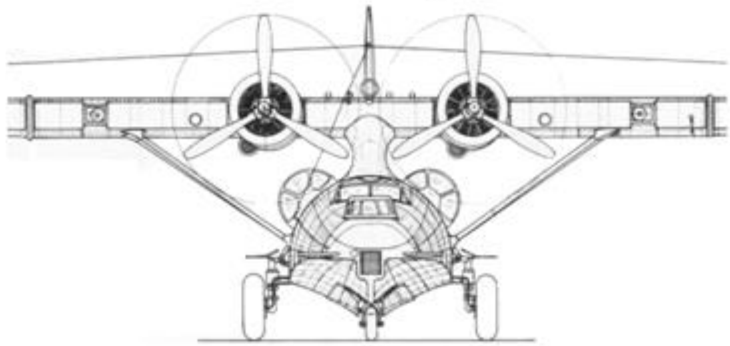
Fig 3

## AIRFRAME

### 1.1 General

a. **The Wing** is mounted on a superstructure built up from the hull, and is braced by four struts, two on each side, extending from the hull to the under surface of the wing. Wing main center and outer panels are aluminum alloy, beams and truss, stressed skin construction, with detachable trailing edges made of braced metal ribs covered with doped fabric. Leading edges of both center and outer panels are all metal covered, and are detachable. The wing also incorporates the engine nacelles, fuel and oil tanks and the two retractable auxiliary floats and their operating mechanism.

Parasol Wing



**Parasol Wing**
Is a design in which the wing is not mounted directly to the fuselage, but rather, the fuselage is supported beneath it by a set of struts. On flying boats, the parasol wing is held above the fuselage by means of a closed structure known as a pylon.

Fig 4

b. **The Two ailerons** and their trailing edge fairings are constructed of braced metal ribs, fabric covered. The port aileron has a metal trim tab which may be adjusted by the pilot during flight.

c. **The Stern** portion of the hull tapers to a point in a horizontal plane, and sweeps upward vertically to form a dorsal fin, which becomes the lower section of the vertical stabilizer.

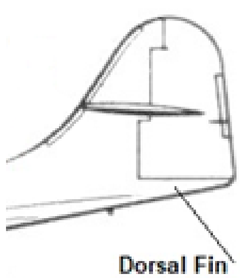



Fig 5

The horizontal stabilizer and upper part of the vertical stabilizer are bolted to the hull portion of the vertical stabilizer. The horizontal stabilizer is all metal except for its trailing edges, which are metal frames, fabric covered.

## AIRFRAME

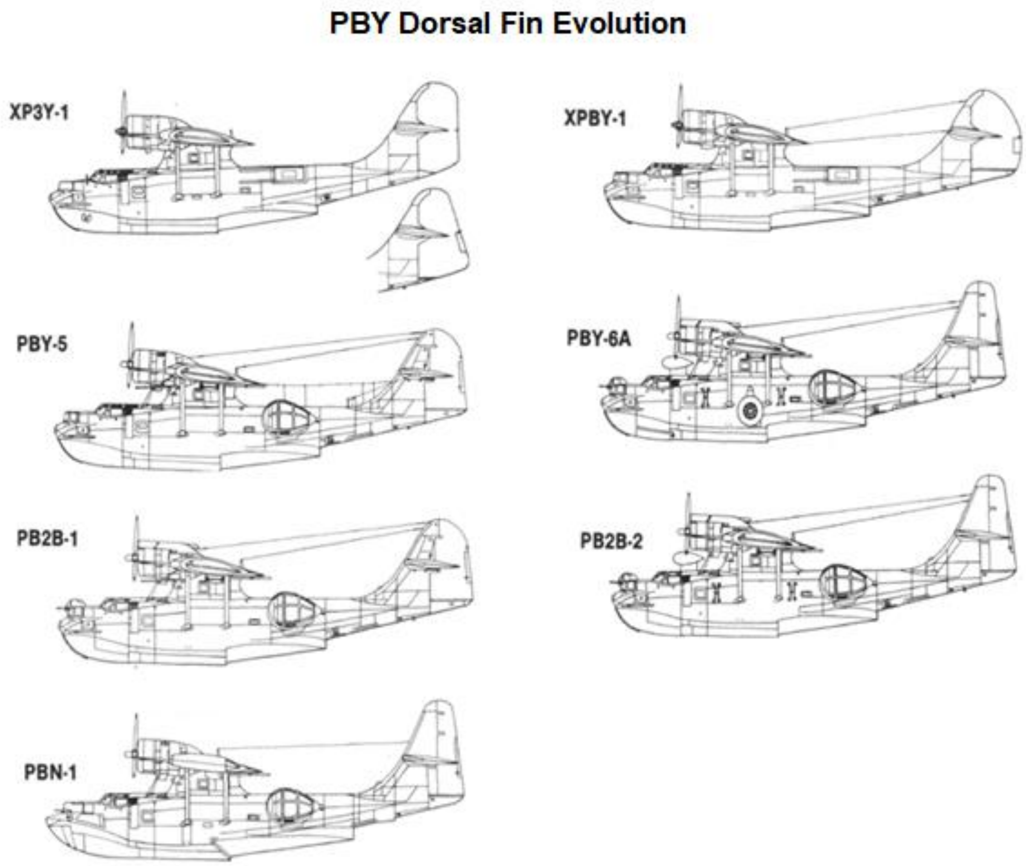



Fig 6

d. **Rudder and Elevator** are also metal frames, fabric covered. Both rudder and elevator have metal trim tabs which may be adjusted by the pilot during flight.

e. **The Hull** is divided into five main compartments, separated by four main bulkheads. These compartments are described in Chapter 6 of this manual.

### 1.2 OPERATING EQUIPMENT AND CONTROLS – PILOTS COMPARTMENT

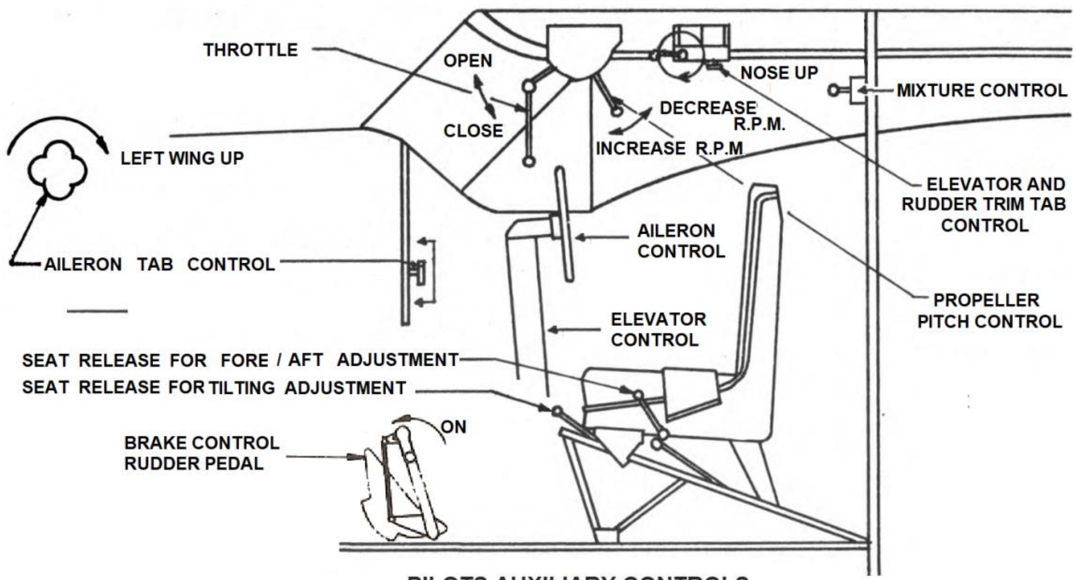
a. **Surface Controls** - Dual surface controls are provided for pilot and co-pilot. Rudder control is in the form of two sets of pedals. Elevator control is in the form of a moveable yoke, with its two vertical supports on either side of the cockpit, and a horizontal bar, parallel with the instrument panel, joining the tops of the two vertical members. Elevator control is achieved by moving the yoke forward or aft in the conventional manner.

## AIRFRAME

### Surface Controls (continued)

b. **Aileron controls** consist of two hand wheels mounted on the horizontal yoke bar at the pilots and co-pilots positions, and linked together by a chain and cable loop sprockets

c. **Metal trim tabs** are installed on the rudder, elevator and port aileron. The aileron trim tab is controlled by a knob at the bottom of the pilot's side of the instrument panel. The rudder and elevator tabs controls are located overhead in the ceiling of the pilot's compartment.




PILOTS AUXILIARY CONTROLS

Fig 7

d. **Elevator and Aileron controls** are locked by means of a detachable bar, one end of which is fitted against the pilot's aileron wheel in such a manner as to clamp the wheel in the neutral position to the control yoke. The bar is strapped to the yoke and the yoke is pulled back until the opposite end of the locking bar meets a fitting, near the side of the hull, aft of the pilot's seat. When the bar is secured in this fitting, it holds the elevator control yoke in neutral position.

e. **The Rudder** is locked by means of a hinged lever which pulls out from the side of the hull, just under the pilot's side window.

f. **External control locks** are also provided for rudder, aileron and elevator control, and should be placed in position if the aircraft is to remain out-of-doors for extended periods.

## AIRFRAME

### Surface Controls (continued)

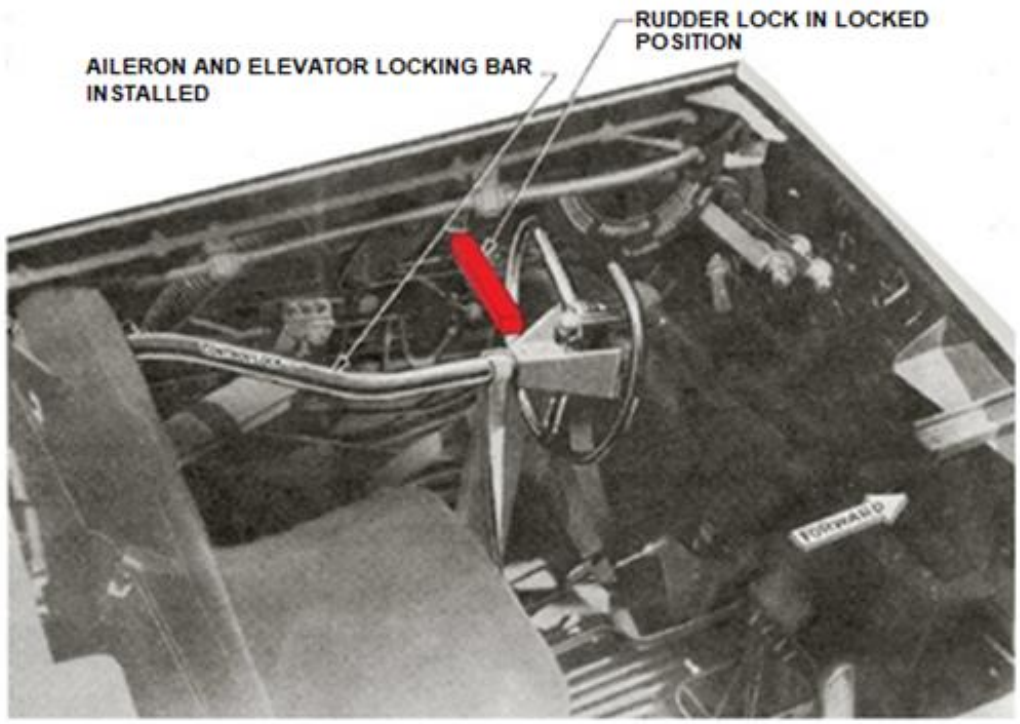



Fig 8

1.3 **Landing Gear Controls** – Pilots Compartment

a. **The operating control** for the hydraulic landing gear lowering and retracting mechanism consists of a small lever at the bottom of the main instrument panel on the pilot's side. Pedals to operate the landing wheel brakes are mounted on the top of the Rudder Pedals. A parking brake setting Knob is located at the bottom of the main instrument panel on the co-pilots side.

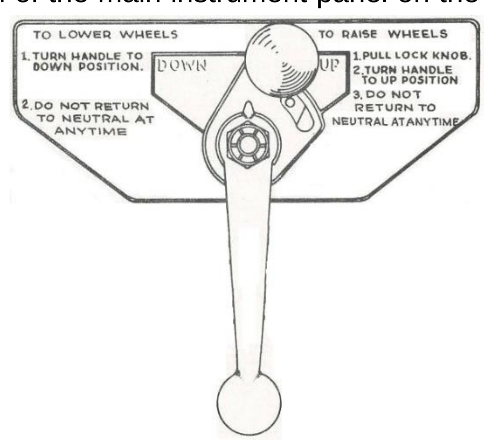



Fig 9

## AIRFRAME

**Landing Gear Controls** – Pilots Compartment (continued)

b. **A hand pump** to furnish pressure to the landing gear and brake system in case of failure of the engine-driven hydraulic pump is located inboard of the co-pilots seat, and is accessible to both pilots. All aircraft are also equipped with an Electric Hydraulic Pump.

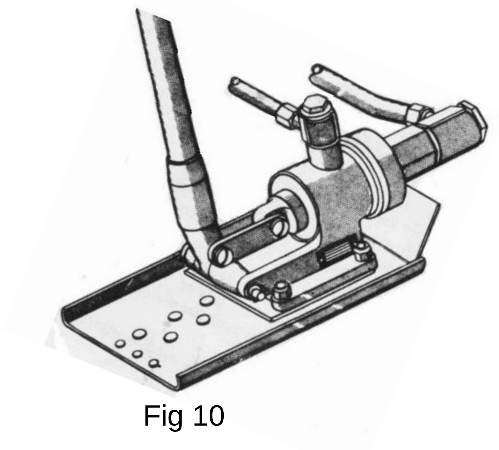


Fig 10

1.4 **Power Plant Controls – Pilot's Compartment**

a. **Basic System** – In the original version of the PBY-5A the pilot's power plant controls consisted of throttles, located in the ceiling of the pilot's compartment between the two pilot positions; propeller governor control levers, alongside the throttles; propeller feathering switches, ahead of the propeller governor levers; and ignition switches, on the control yoke bar. All other power plant controls are located in the engineer's compartment.

b. **Modified System –** In our version of the PBY-5A the power plant control system has been modified to place all engine controls in the pilot's compartment, thus eliminating the requirement of a flight engineer. These controls include the following:

(1) Carburetor air Control handles
(2) Cowl Flap Controls
(3) Engine Starter and Meshing Switches
(4) Engine Primer
(5) Fuel Tank Selector value
(6) Fuel Cross-feed Value
(7) Fuel Electric Pump Switches
(8) Mixture Controls

# AIRFRAME

## c. Miscellaneous Controls

(1) **Vacuum Pump Selector Valve** – This valve is located at the bottom of the instrument panel on the pilot's side. The valve may be set so that the right-hand pump will run gyro pilot and the left-hand pump will run the Directional Gyro and Gyro Horizon; or so that the left-hand pump will run the gyro pilot, and the right-hand pump will run the Gyro Instruments. The selector valve has been removed from some of the PBY's

(2) **Pilots Seat Adjustments –** the pilot and co-pilot's seat may be adjusted for tilt and for fore-and-aft positions by releasing the spring loaded locking pins controlled by levers on the outboard side of the seats.

(3) **Rudder Pedal Adjustments –** Both sets of rudder pedals may be adjusted for fore-and-aft position by releasing spring-loaded locking pins controlled by levers which may be moved with the feet. The levers are on the outboard side of each pedal.

(4) **Pilots Compartment Ventilation Controls –** Openings in each side of the hull immediately aft of the instrument panel, provide for admission of fresh air during flight. These openings are closed with water tight hinged covers during take-off and landings. Knobs controlling opening, closing and locking of the covers are within easy reach of the pilot and co-pilot. Pilot's and co-pilots side windows have sliding panels which may be opened for additional ventilation. The overhead emergency exits should not be opened during flight.

(5) **Pilots Electrical Switch Panel** - This panel is located over the bulkhead door, to the rear of the pilot's seats, and contains switches for operating the pitot heaters, landing and navigation lights, cabin and cockpit lights, and in some cases many of the switches that may have been previously located in the engineer's compartment.

(6) **Firewall Shut-Off Valves –** the firewall shut-off valves are electrically actuated by switches located behind the right and left shoulders of the pilot and co-pilot positions, respectively, or in some cases side by side behind the pilot's right shoulder position, against the bulkhead. The switches incorporate safety covers and are painted red.

(7) **Radio Equipment Controls –** the controls for operating the radio's and navigation equipment may be placed in various locations, either on a switch panel on the bulkhead behind the pilot's seats, on the control yoke, or occasionally on the center instrument panel, particularly if the automatic pilot panel has been removed.

## AIRFRAME

**Miscellaneous Controls** (continued)

**CAUTION** *It is vitally important that pilots are completely familiar with the location of all operating controls associated with the various aircraft being flown. Due to the numerous modification that the PBY-5A has been subjected to in the course of its long history, particularly in the case where the engineer's controls, switches etc., have been relocated in the pilot's compartment, it is unlikely that any two PBY-5A's are exactly similar in cockpit configuration. A thorough cockpit familiarization should therefore, be made by both pilots before flight*

### 1.5 Instruments in Pilots Compartment

a. **Flight and Navigation Instruments –** Pilot – The pilot has the following flight and navigation instruments on his side of the main instrument panel:

| | |
|---|---|
| Altimeter | Rate of Climb Indicator |
| Air Speed indicator | VOR Indicator (Optional) |
| Directional Gyro | Clock |
| Gyro Horizon | ADF Indicator (Optional) |
| Turn and Bank Indicator | ILS Indicator (Optional) |

b. **Co-Pilots Instruments:**

| | |
|---|---|
| Altimeter | Rate of Climb Indicator |
| Air Speed indicator | VOR Indicator (Optional) |
| Directional Gyro | Clock |
| Gyro Horizon | ADF Indicator (Optional) |
| Turn and Bank Indicator | ILS Indicator (Optional) |

c. **Modified Instrument System –** In the modified PBY-5A's, ie., Engineers controls and instruments transferred to the pilot's compartment, the following engine instruments will be located on the center main instrument panel:

| | |
|---|---|
| Fuel Pressure Gauges | Cylinder Head Temp Gauges |
| Oil Pressure Gauges | Fuel Pressure Warning Lights |
| Carburetor Air Temp Gauges | Oil Pressure Warning Lights |
| Outside Air Temp Gauges | Fire Warning Lights |

## AIRFRAME

d. **Other Instruments and Indicating Lights**

(1) The marker beacon lights, if installed, are on the main instrument panel to the left of the center panel.

(2) The landing gear hydraulic pressure gauge is on the co-pilot's side of the main instrument panel. It may be located differently in some aircraft.

(3) Landing gear up and down latch indicator lights are on the co-pilot's side of the instrument panel, but may be located differently in some aircraft.

### 1.6 Engineer's Compartment (Conning Tower Superstructure)

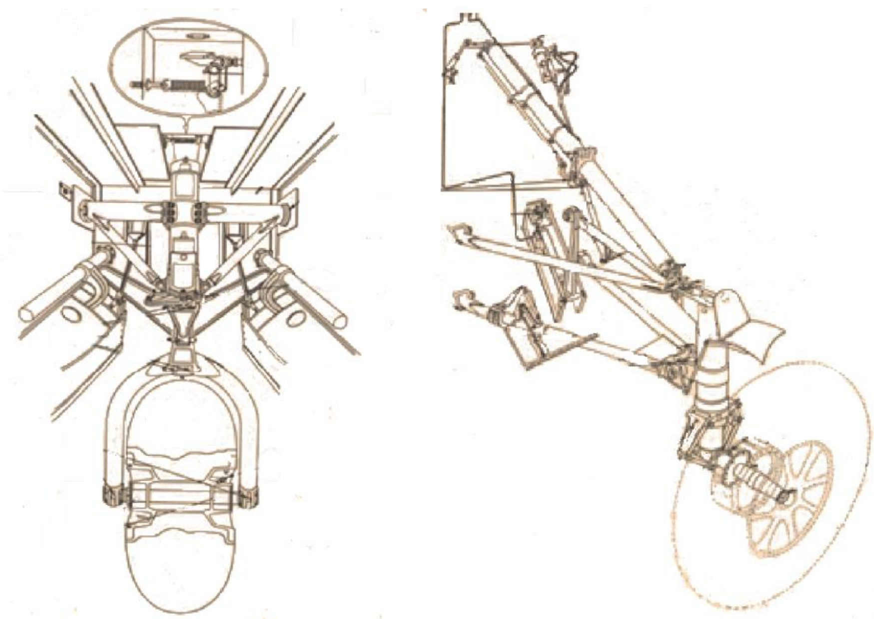
a. The Electric Fuel Pumps and Fuel Strainers in ***C-FUAW*** are located in the fore section of the Pylon Superstructure (looking towards the cockpit).

b. Fuel tank drain valves on ***C-FUAW*** are on either side of the upper aft section of the Pylon superstructure.

### 1.7 MAIN POWER DISTRIBUTION PANEL

*a.* The main power distribution panel is located, generally, in the left, forward face of bulkhead 4 in the forward cargo compartment. The panel contains the main and the auxiliary battery ammeters; the main and auxiliary generator ammeters; the voltmeter and its selector switches; the bus selector or line switches for all the electrically operated equipment on the aircraft. *In **C-FUAW** the ammeters have been moved to the cockpit behind and between the pilot's seats.*

# LANDING GEAR



# LANDING GEAR AND BRAKES

## 1.8 General Description

The PBY5A aircraft is equipped with a tricycle landing gear consisting of two main gears and one nose gear. The entire landing gear is retractable, being activated by hydraulically operated cylinders which are controlled by a selector valve and handle located under the pilot's panel. The two main gears retract into wheel wells in the side of the hull. The nose gear retracts into a wheel well in the bow of the hull. Doors close over the nose wheel well after the gear is retracted and opens before the gear is extended.

All three units are provided with up and down locks which engage automatically when the gear reaches the fully extended position or retracted position, and release automatically at the beginning of retraction or extension.

Each main unit is equipped with a hydraulic pneumatic shock strut mounting a water tight wheel and brake assembly and a pneumatic tire.

Brakes are of the disc type and are operated by means of hydraulic pressure supplied by the main hydraulic system through a brake control valve which in turn is operated from extensions on the rudder pedals. *If the co-pilot's brake pedals are operated, it is not possible to operate the pilot's brake pedals*.

The nose landing gear is equipped with a hydraulic pneumatic shock strut which mounts a wheel and tire assembly and a shimmy damper.

A signal light on the pilot's instrument panel indicates "WHEELS DOWN" when both main landing gear wheels and the nose wheel are locked in landing position. Signal lights indicate "WHEELS UP" when the main landing gear unit has been raised and “WHEEL DOORS LOCKED when the nose wheel has been retracted and the door closed and latched. The position of the gear may be determined at any time by placing the indicator switch in the "INDICATION LIGHTS" position and observing which lights are illuminated. At all other times, the switch should remain in the "WARNING LIGHTS" position. With the switch in this position, no indication can be obtained unless the throttles are cut, whereupon the lights will register as though the switch were in the "INDICATION LIGHTS" position.

## LANDING GEAR AND BRAKES

### 1.9 LANDING GEAR OPERATION

#### a. Normal Main Gear Extension

(1) Pull safety catch on landing gear control lever

(2) Lower lever to “DOWN” position

(3) The Gear Light indicating “Main Landing Gear Down” and “Nose Wheel Door” will show until the main wheels are both securely latched and the Nose Doors are Open

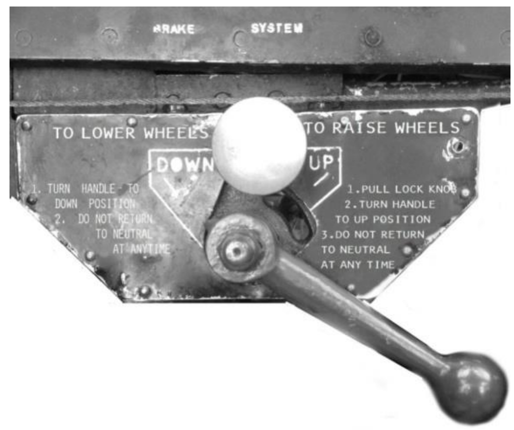



Fig 11

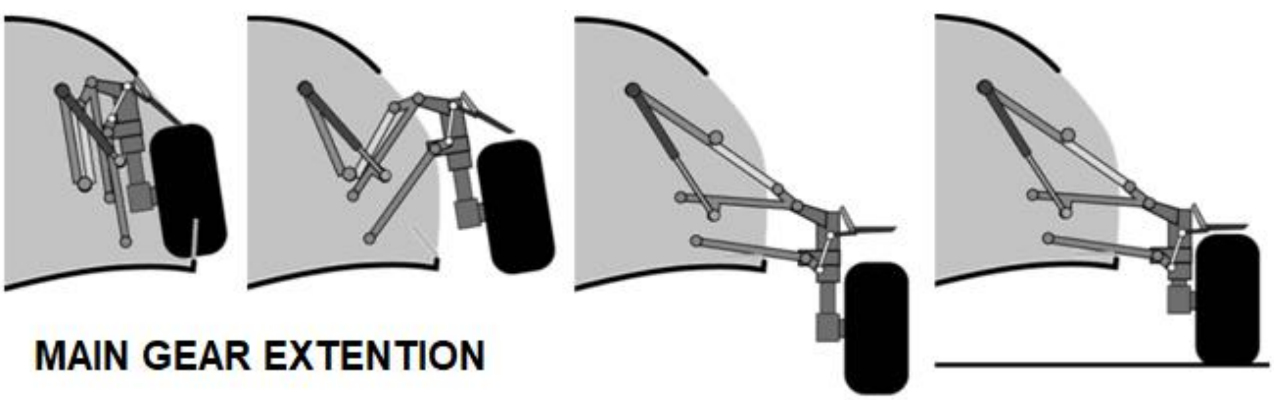



Fig 12

## LANDING GEAR AND BRAKES

**Normal Main Gear Extension** (continued)

When the side unit is to be extended, another small actuating cylinder releases the "retracted position" latch, the main actuating cylinder extends, forcing the unit out into the extended position, and the main strut automatically latches in a rigid position.

b. **NORMAL MAIN GEAR RETRACTION**

(1) Pull safety catch on landing gear control lever
(2) Raise lever to “UP” position
(3) The two lights indicating “Main Landing Gear Up”, and “Nose Wheel Door Locked” will not show until the main wheels are both securely latched and the nose doors are closed and latched.

Retraction of each side unit is accomplished by the operation of two actuating cylinders. The small actuating cylinder near the upper hinge point of the main strut actuates a rod outside the strut by means of a bell crank also at the upper hinge point. This rod released the spring-loaded strut latch, causing the main strut to be folded inward by the action of actuating cylinder. The main actuating cylinder floats between a bracket near the upper end of the main strut and a bracket on the forward leg of the upper V-strut. By contracting, this actuating cylinder applies torque to the strut system, folding the main strut inward, and pulling the gear upward and into the well. On the inboard end of the wheel axle is a fitting equipped with a roller which, upon coming in contact with a spring bumper arm assembly in the well, cushions the shock of the fall as the gear reaches full retraction. This is necessary because the gear, in approaching its retracted position, has a tendency to fall into the well. This fitting, at the same time, is caught by a spring latch in the well which holds the unit in the retracted position.

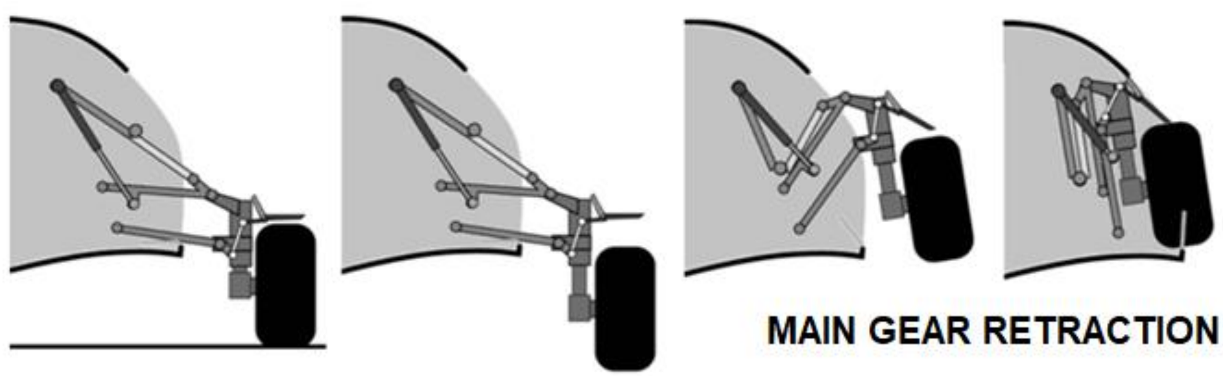



Fig 13

## LANDING GEAR AND BRAKES

**NORMAL MAIN GEAR RETRACTION** (continued)

**CAUTION** ***The gear control lever must be either "FULL UP" or "FULL DOWN" at all times. Do not allow it to remain in any intermediate positions.***

c. **NOSE WHEEL RETRACTION -** Retraction of the nose unit is accomplished by the operation of two hydraulic actuating cylinders. The small actuating cylinder releases the spring latch which locks the unit in the extended position, allowing the main actuating cylinder to pull the unit up into the well. When fully retracted, a hook on the damper support plate is engaged by an automatic spring latch in the well, holding the unit in the retracted position.

d. **Nose Wheel Extension -** When extending the unit, another small actuating cylinder releases the "retracted position" latch and the main actuating cylinder rotates the unit to the fully extended position, where the "extended position" latch engages a fitting on the forward side of the oleo.

**CAUTION** **Do not operate with flat nose oleo because it self-centers the nose wheel in retraction and extension.**

e. **Nose Gear Doors -** Doors which cover the nose wheel well operate hydraulically in sequence with the nose wheel. In retracting the nose wheel, a sequence valve is opened at the end of the travel which allows fluid to go to the nose wheel door cylinder and close the doors. The sequence valve is located on the starboard side of the starboard auxiliary keel in such a position that a small extension on the main retracting crank engages the plunger in the valve. The valve has a snap action and is so adjusted that the nose gear is all the way up and latched before the valve is opened. Similarly, there is a valve on the door cylinder which allows fluid to go to the retracting cylinder when the gear is lowered. This valve is closed at all times except when the doors are open.

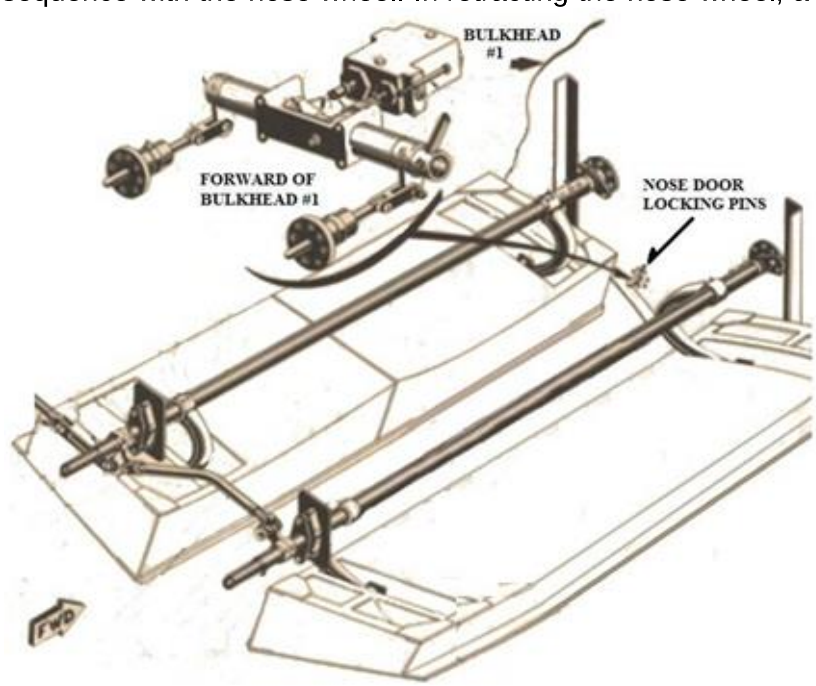



Fig 14

## LANDING GEAR AND BRAKES

**NORMAL NOSE GEAR RETRACTION** (continued)

f. **Visual Check -** It is possible to observe the position and operation of the nose wheel through a small window in the flooring of the pilot's compartment. There is a plugged hole through the compartment flooring at the forward end of the nose wheel well; a rod is supplied which, in an emergency, may be inserted through this hole far enough to touch the "extended position" latch. If the red band on the rod extends above the top of the hole, the latch has not caught. Striking with the end of the rod will push the latch into place. This procedure should be used if the indicator lights do not work or if there is any doubt whether the gear is down and locked. In checking for the gear down position, it is important to observe through.

LANDING GEAR WARNING SYSTEM
PBY-5A AND 28-5ACF

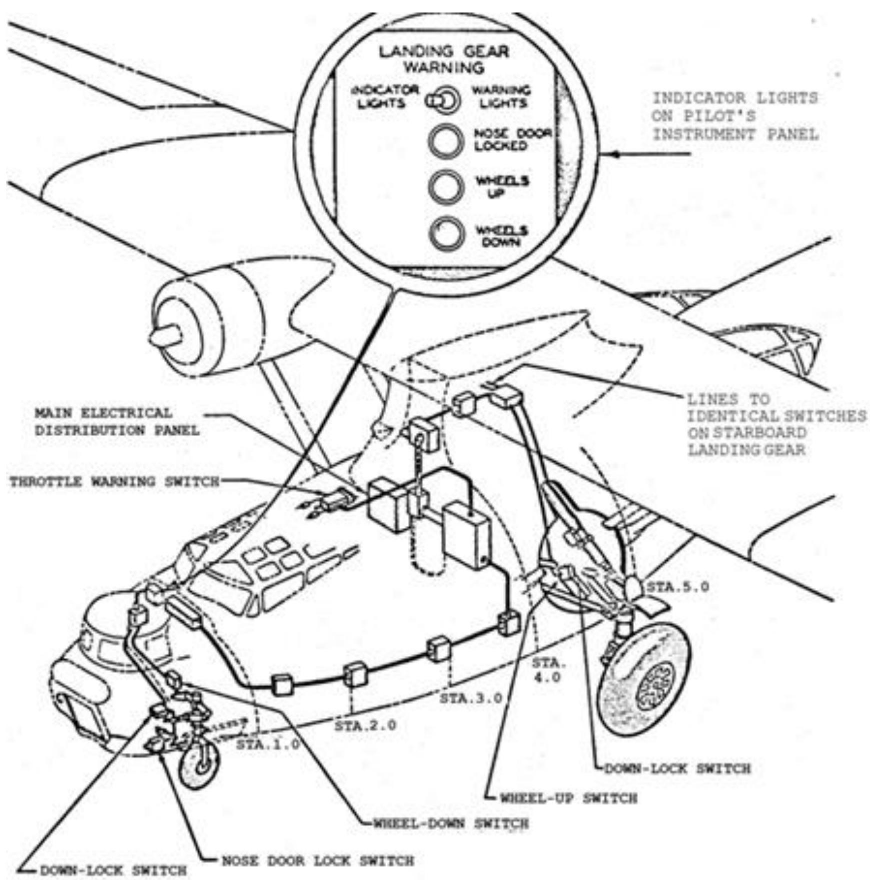



Fig 15

## LANDING GEAR AND BRAKES

1.10 **GEAR OPERATING SPECIFICATIONS -** The main landing gear legs extension should by 1-1/2" above the red line on the piston when fully loaded. (4" empty). The nose gear strut should be 2" min. above the red line on the piston in all weight configurations.

Note: **C-FUAW normal operational tire pressures are Main Wheels 55 psi and Nose Wheel 40 psi**

a. Main and Nose Tire Pressures

(4) Tire inflation main wheels at 30,000 lbs ............................ 58 PSI

at 27,000 lbs............................. 51 PSI

(5) Tire inflation nose wheels at 30,000 lbs .............................. 43 PSI

at 27,000 lbs .............................. 41 PSI

(6) Tire inflation main wheel operational weight 30,000 lbs ....... 45 PSI

(7) Tire inflation nose wheel operational weight 30,000 lbs ...... 35 PSI

## LANDING GEAR AND BRAKES

1.11 **PBY Brakes -** Wheel brakes are the disc type with the alternating discs. The stationary discs are keyed to an anchor bracket on the axle and the rotation discs are keyed into splines in the wheel. The rotation discs have steel cores with bronze friction material on both sides – the friction material bears against the non-rotation steel discs when the entire set of discs is squeezed together by the annular ring piston. An insulator disc is located between the piston (which resembles an extremely over-size hollow mason-jar seal ring) and the first steel disc. This asbestos disc prevents heat from the steel disc reaching the piston and vaporizing the hydraulic fluid. Hydraulic pressure exerted by the annular piston comes from the 10 inch (inside) diameter accumulator located on the starboard side of the cockpit by way of the brake valve and brake deboosters. The 10 inch accumulator (Vickers AA-14005) is for brake system only and is charged with 600 lbs/psi of air. The accumulator is divided into two halves separated by a membrane. Pressure from the accumulator is used as follows :The deboosters valve (one for each wheel brake) consists of a steel cylinder fitted with a spring loaded piston that divides the cylinder into two pressure chambers – on is a high pressure low volume chamber connecting directly to the brake control valve. The other is the low pressure large volume chamber connecting directly to the wheel brakes. When the pressure from the brake control valve is diminished or released, the piston return spring drives the piston away from the outlet end and thereby unloads a corresponding amount of fluid from the wheel brake which consequently releases the brake piston.

If the co-pilot's brake pedals are operated, it is not possible to operate the pilot's brake pedals.

The brakes are powerful and sensitive, making it an easy matter to taxi in a straight line with only the barest touches of brakes to keep the aircraft straight. Another reason for keeping the rudder locked while taxiing is that, because of the large rudder travel, it is often difficult to apply brake effectively or evenly in the full left or right rudder position, and even more difficult to apply full brake in the intermediate positions. The brakes should be tested immediately when the aircraft begins to move. The time to discover brake unserviceability is on the line.

## LANDING GEAR AND BRAKES

**PBY Brakes** (continued)

1.12 **Brakes Operational Check:** to check the brakes, the airplane should be taxied. Apply both right and left brakes individually and then together. Apply brakes with a light but steady push to check for smooth braking action.

1.13 **Use of brakes on landing roll-out.** Brakes should be used sparingly in order to reduce wear and to lessen the risk of fire. The amount of heat generated by even normal use of brakes is surprisingly high. Unnecessary use of brakes is to be avoided, particularly on landing roll-out..It is better airman ship to allow the aircraft to roll-out to a stop or slow taxi speed right the end of the runway rather than to snub it to early stop and return the parking ramp with heated discs causing danger to the tires and warping of the brake unit. Such extreme heat will get past the insulator disc and may rupture the annular piston causing a loss of brake power. Unless demands of traffic, length of runway or a hazardous condition dictate otherwise, aircraft shall be allowed to roll-out on landing to a slow speed before brakes are activated.

**CAUTION** *Depress both brake pedals fully and set throttles at 2700 RPM or 35" MP. The brakes should be capable of holding the airplane against the thrust produced.*

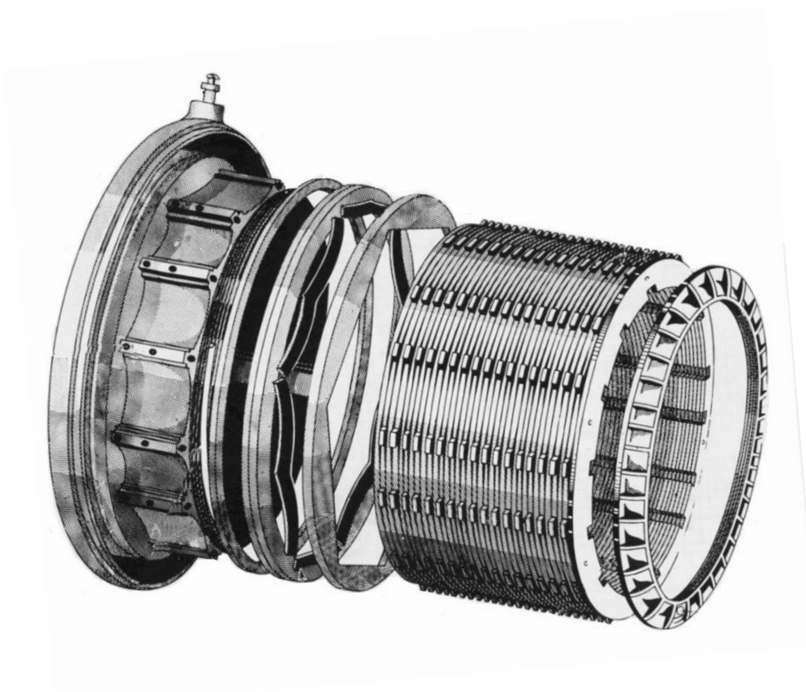
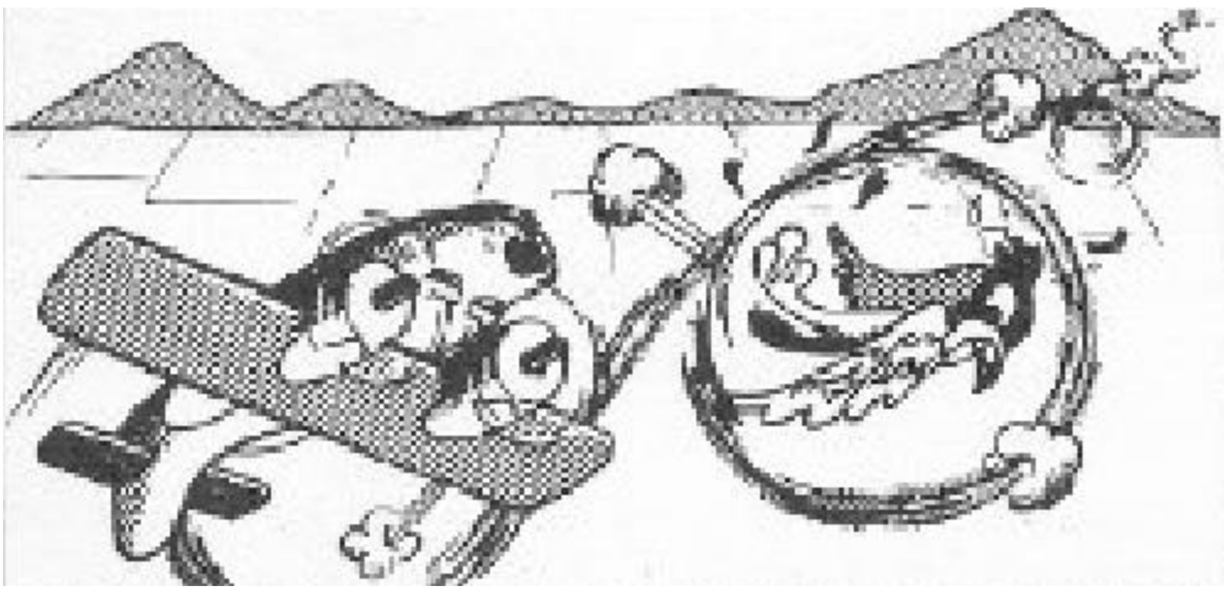


Fig 16

# OPERATING LIMITATIONS



## OPERATING LIMITATIONS

### 1.14 Airspeed Limitations

| | |
|---|---|
| Never Exceed Speed (VNE) | 173 Kts |
| Structural Cruising Speed (VC) | 137 Kts |
| Maximum Speed-Gear Lowering | 122 Kts |
| Maximum Speed-Gear Extended | 139 kts |
| Manoeuvring Speed (VA) | 106 Kts |
| Minimum Control Speed (VMC) | 76 Kts |
| Safe Single Engine Speed (VSSE) | 84 Kts (110%VMC) |
| Single Engine Climb Speed (VSE) | 87 Kts |
| Float Lowering Speed | 122 Kts |
| Maximum Demonstrated Crosswind | 15 mph @ 90°<br>13 kph @ 90° |

### 1.15 Power Limitations

| | |
|---|---|
| **Power Plant …...** | Pratt & Whitney R 1830-92 (S1C3-G) |
| **Propeller ………** | Hamilton Standard Hydromatic (3 blades)<br>Hub - 23E50 - Blades - 63531-12-Pitch -<br>Feathered - 88 Low - 16 (at 42 in. sta.) |
| **Engine …………** | Prop Gear Ratio - 16 to 9 |
| **FUEL ……………** | Minimum Octane - 91 (the dash one (-1) carburetor setting on PD12H4 or 114 carburetors is satisfactory for 91 or 100 octane fuel with 25 BTC ignition timing) |
| **Power Limits …** | Max. Take - Off -1200 BHP, 2700 RPM - 48" MP |
| **Engine RPM ….** | The engine speed range of 2,450 to 2,650 RPM should be avoided as it may produce a vibration in the structure of the aircraft. |
| **Time Limits ……** | Max. Take-Off Power-2 Minutes - Water 1 Minute - Land<br>Max. Continuous (Sea Level)-1050 BHP, 2550 RPM - 42.5" MP<br>Max. Continuous (7500’) - 1050 BHP, 2550 RPM - 39.5" MP |

## OPERATING LIMITATIONS

| Temperature and Pressure Limits | T/O | Climb |
|---|---|---|
| **Cylinder Head Temperatures ................** | 260°C | 232°C |
| **Cowl Flap Settings .....................................** | May be set as required for all operations Oil temperatures are controlled thermostatically. | |

**CAUTION** ***DO NOT START TAKE-OFF WHEN ENGINE HEAD TEMPERATURE EXCEEDS 200 °C***

**CAUTION** ***DO NOT EXCEED ENGINE TEMP LIMITS DURING WATER TAXIING***

* **Pratt & Whitney Service Bulletin 1659**

| | |
|---|---|
| **Oil Temperature ...............................** | 100°C Maximum |
| **Oil Pressure ....................................** | 100 PSI Maximum |
| **.........................** | 65 PSI Minimum |
| **Fuel Pressure .................................** | 17 PSI Maximum |
| **.........................** | 14 PSI Minimum |

1.16 **Flight and Power Instrument Color Coding:**

| | |
|---|---|
| **Red Radial Line ..........................................** | Maximum or Minimum Limits |
| **Yellow Arc ..................................................** | Caution Range |
| **Green Arc ...................................................** | Normal Operating Range |

1.17 **Weight Limitations**

| | |
|---|---|
| **Take-Off ......................................................** | Wheels - 30,500 lbs |
| **(Waves over 2 ft).............** | Water - 28,000 lbs |
| **(Waves under 2 ft) ............** | Water - 30,500 lbs |
| **Landing .................................................** | Wheels - 28,000 lbs(12 ply tires) |
| **................** | Water - 27,000 lbs |
| **28- 5 ACF (Clipper Nose)............................** | Water – 28,000 lbs |

## OPERATING LIMITATIONS

### 1.18 Centre of Gravity Limitations

**Forward C of G Limit ……………….....……….** 22.9% Mac (242.2 inch)
**Aft C. of G. Limit ……….........………………….** 28.5% Mac (251.5 inch)
**Datum ………………………......…………………** .3 inches aft of the bow nose

a. **Manoeuvres**

***NO AEROBATIC MANEUVERS ARE PERMITTED - 30 BANK MAX***.

b. **Flight Load Factor Limitations (in "G" Units)**

**Gust .......................................** Pos 2.84 Neg - 0.84 at Vc (137 Knots - 158 MPH)
**……** Pos 2.27 Neg - 0.27 at Vne(173 Knots - 199 MPH)
**Manoeuvres ........................** Pos 2.73
**..…..** Neg 1.10

c. **Speed Limitations and Restrictions**

(1) Maximum engine over-speed - 2800 TO 3050 RPM – Engine Inspection
(2) It is good practice to slow down to 100 Knots in extremely turbulent air
(3) All manoeuvres are prohibited except those prescribed for normal flight
(4) Harmonic Vibrations - Avoid: Below 1700 and 2100 to 2300 RPM
(5) Do not lower undercarriage in excess of 122 knots
(6) Floats should not be lowered at indicated speeds greater than 122 knots

Restricted speeds for gross weights in excess of 26,000 pounds are given in the Table below. The restricted speed for any load in extremely rough air is 100 knots.

| GROSS WEIGHT | PERMISSABLE MAXIMUM SPEEDS |
|---|---|
| 26,000 pounds | 165 knots |
| 28,000 pounds | 152 knots |
| 30,000 pounds | 144 knots |

### 1.19 Minimum Flight Crew

Land and Water – Two (2)
- 1 Pilot
- 1 Co-Pilot

### 1.20 Wave Height

Two (2’) feet maximum for landing

## OPERATING LIMITATIONS

### 1.21 Flight Placards - Pilots' Compartment

**CAUTION** This airplane must be operated in compliance with the approved Operating Limitations

a. NO AEROBATIC MANEUVERS, including spins, approved
b. DO NOT EXCEED Engine Temperature Limits during Water Taxiing

### 1.22 Operations Authorized

This airplane is authorized for - Night, Instrument, land and/or Water Operation when the required equipment is installed

a. **Taxiing limitations**

**CAUTION** Extreme caution should be exercised during high speed water taxiing as the engine temperatures may exceed their limits.

b. **Rudder Lock**

**CAUTION** If large side-slip or skidding is produced by nearly full use of rudder at speeds of 110 knots or lower, the rudder may lock over. The nose will rise and the wing drop sharply, even against full opposite aileron. Control can be recovered by putting the nose down and increasing speed to 120 knots; the engines should be throttled back and the rudder then forced back. Much opposite aileron should not be used until the rudder centralizes as it increases side-slip.

### 1.23 Use as an Oil Tanker

a. If the aircraft is used for tanking purposes the following placard shall be placed in the flight compartment:

**CAUTION** **"When used as an oil tanker the port tank shall be isolated from the main fuel system by the shut-off valve located in the pylon".**

b. When this has been carried out the following placard shall be placed on the port fuel selector:

***"Port tank isolated".***

c. The following placard shall be exhibited by the Starboard fuel tank filler cap:

***"Aviation gas only in this tank".***

**CAUTION** **In NO instance will the weight of fluid carried in the isolated tank exceed the weight of a full tank of aviation gasoline (5184 lbs).**

### 1.24 Fuel Tanks

a. 1 Left - 728.8 Imperial Gallons

b. 1 Right- 728.8 Imperial Gallons

**OPERATING PROCEDURES**

## OPERATING PROCEDURES

### 1.25 NORMAL OPERATING PROCEDURES

Before entering the plane, check to see that all engine covers and flight control locks are removed and stowed. On land check the wheel chocks are in place and the tires properly inflated to 55 psi and the main gear strut has a 4 fingers width clearance. Check the nose wheel is inline with the keel and inflated to 40 psi. the nose wheel strut again should have 4 finger width clearance. If the plane is moved before flight, check the alignment again. Check to ensure the three (3) gear pins have been removed and stowed. Check that all Hull and Float Plugs (14) are installed. Remove any visual indication of birds' nests from the empennage and other control surfaces including the engine compartment. Ensure the pitot heat cover is removed and stowed. All engine wrap covers and maintenance inspection covers are secured. Check the fuel levels located just aft and between the engines ensuring the dip stick misses the lower bottom of the fuel tank stringer. Check hydraulic level with the dipstick located in the rear starboard engine nacelle. Check the Engine Oil levels at the rear of each engine by opening the oil filler cap and pulling the dipstick up. Ensure all fluid caps have been secured.

Soon after going aboard check the APU fuel level (2 cycle ONLY!) and ensure the engine RUN switch is ON, the exhaust system is in good working condition. Before starting the APU open the compartment upper ventilation hatches until time for take-off.

Ensure blisters are closed and locked, load is secured and bilges are clean and water drained.

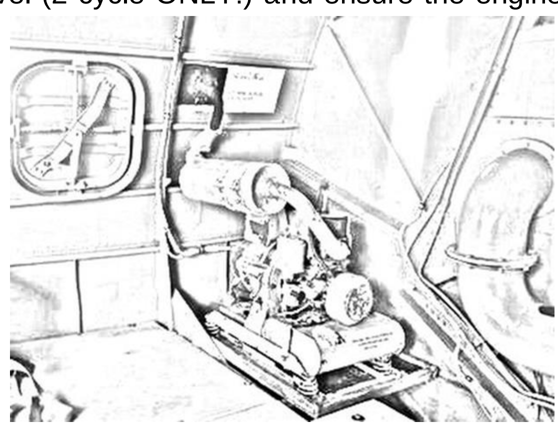


Fig 17

a. **Before-Flight Inspection -** It is the responsibility of the Pilot-in-Command to perform a routine "Pre-Flight Inspection" of the aircraft. This is to be a complete walk-around inspection. It is also required that a brief but thorough walk-around inspection be performed prior to boarding the aircraft at all stops to ensure that all exits, doors, hatches, etc., are properly closed, external control locks removed and that the aircraft has not been inadvertently damaged between flights.

b. **Cockpit Checks -** It is the responsibility of the Pilot-in-Command to ensure that the Pilots' Check List is properly used in a challenge reply manner for each phase of flight. One pilot will read the appropriate Check List and will not proceed beyond an item until he has received the correct reply from the other pilot.

## OPERATING PROCEDURES

### 1.26 PBY FLIGHT SAFETY BRIEFING

**During the START** if a FIRE occurs we will try to consume it by keeping the engine cranking, select Boost Pumps OFF, Mixture to ICO, and OPEN the throttle.

**If no success**, we will shut both engines down. Throttles CLOSED, Mixture ICO, FWSOV Both OFF, Boost Pumps OFF, Cowl Flaps CLOSED, Fire Extinguisher Select and Discharge.

I will vacate to main cabin and assist in the evacuation.

**You** will advise the tower, select the Ignition and Battery Master OFF. Exit via the overhead hatch and assist passengers outside the aircraft.

**During the Taxi**, I will close the throttles, stop the aircraft and set the parking brake, and assess the problem.

**During the Takeoff** if an abnormality occurs prior to 80 KTS, I will call Continue or Reject, if the decision is to reject I will close the throttles and land straight ahead. Once the aircraft has come to a stop set the parking brake and assess the problem and call for the appropriate drill or checklist.

**Above 80 KTS** if insufficient runway remains we will continue flying, I will call for Mixtures AUTO RICH, Props FULL FINE, and throttles to 48”. I will maintain 85 KTS, select GEAR UP and FLOATS UP. You will select the HYD BOOST PUMP ON.

**If an engine failure has occurred** we will identify which engine, I will verify by slowly retarding the failed engine throttle to CLOSE, Pitch Lever to full COARSE, and mixture control to ICO, and press the Failed engine FEATHERING BUTTON. **Confirm button pops out.**

**If there’s a fire** then we will carry out the fire drill, select failed engine Boost Pump OFF, Cowl flaps CLOSED, FWSOV Both CLOSED, Fire Extinguisher Select and DISCHARGE.

I will call for the appropriate checklist, notify ATC and we will land ASAP.

## OPERATING PROCEDURES

### 1.27 LAND CHECKLISTS

#### a. BEFORE FLIGHT — LAND

| ***CAPTAIN*** | ***F/O*** |
|---|---|
| **EMERGENCY BRIEFING ..........................** | *COMPLETE* |
| **LOG BOOK ..................................................** | *ON BOARD* |
| **FLIGHT PLAN – WT & BALANCE ................** | *ON BOARD* |
| **EXTERNAL CHECKS ....................................** | *COMPLETED* |
| **FUEL – OIL – HYDRAULICS ........................** | *STATE QUANTITY* |
| **FLIGHT CONTROLS .....................................** | *FULL & CORRECT* |
| **CIRCUIT BREAKERS ...................................** | *IN* |
| **LANDING & STROBE LIGHTS ....................** | *OFF* |
| **GENERATORS .............................................** | *OFF* |
| **RADIO MASTER ...........................................** | *OFF* |
| **INVERTER ....................................................** | *OFF* |
| **PITOT HEAT ..................................................** | *OFF* |
| **FUEL SELECTORS .......................................** | *RT on RT / LT on LT* |
| **WATER BOMB MASTER ..............................** | *OFF* |
| **FLOAT SWITCH ............................................** | *NEUTRAL* |
| **IGNITION MASTER .......................................** | *OFF* |
| **GEAR SELECTOR .........................................** | *DOWN* |
| **GEAR ISOLATION VALVES .........................** | *OPEN* |
| **BATTERY MASTER ......................................** | *ON* |
| **COWL GILLS ................................................** | *OPEN* |
| **CARB HEAT ..................................................** | *COLD* |
| **AUX HYD PUMP ...........................................** | *ON & PRESS UP* |
| **WARNING & FIRE LIGHTS ...........................** | *CHECKED* |
| **NOSE DOOR LIGHT .....................................** | *CHECKED* |
| **BATTERY MASTER ......................................** | *OFF* |

## OPERATING PROCEDURES

b. **BEFORE START** **LAND**

| ***F/O*** | ***CAPTAIN*** |
|---|---|
| **PAX BRIEF ..................................................** | *COMPLETE* |
| **PARK BRAKE ...............................................** | *SET* |
| **SEATS, BELTS, PEDALS ..............................** | *ADJUSTED* |
| **HATCHES, BLISTERS, EXITS …...................** | *SECURED* |
| **LOCKS, CHOCKS, LADDER, POGO ............** | *STOWED* |
| **CLOCK .........................................................** | *SET* |
| **BATTERY MASTER .......................................** | *ON* |
| **BEACON .....................................................** | *ON* |
| **STATIC MAN.PRESSURE ...........................** | *NOTED XX.XX”* |
| **THROTTLES ................................................** | *SET (1/4”)* |
| **PROP PITCH ................................................** | *FULL FINE* |
| **MIXTURES ....................................................** | *ICO* |
| **APU ..............................................................** | *ON & START* |
| **IGNITION MASTER .....................................** | *ON* |
| **START ENGINES ........................................** | *RH #1. LH #2* |

**OPERATING PROCEDURES**

**C. ENGINE STARTING** **LAND**

***<u>CAPTAIN</u>***

**<u>RH ENGINE</u>**

**RH PROPELLER ..........................................................** *CLEAR*

**RH FUEL BOOST PUMP .............................................** *ON*

**RH STARTER ................................................................** *ENGAGE*

**RH IGNITION *(Count 14 blades cold, 7 hot)* .............** *BOTH*

**RH FUEL PRIMER .......................................................** *AS REQ'D*

**RH MIXTURE(*When stable with prime @ 500 PM)* ...** *AUTO RICH*

***Release primer when engine begins to bog.***

***Stabilize RPM between 600 – 800 RPM***

**RH OIL PRESSURE .................................................** *GREEN & STABLE*

**HYDRAULIC PRESSURE ........................................** *800 – 1000 psi*

**RH FUEL BOOST PUMP ..........................................** *OFF &STABLE*

**RH CARB HEAT ......................................................** *AS REQ'D*

**LH ENGINE ..... REPEAT AS PER RH ENGINE**

**<u>LIMITATIONS:</u>**

**STARTER - 30 Seconds continuous.**

**OIL PRESSURE: Shut down engine if no indication shows within 10**

## OPERATING PROCEDURES

### d. AFTER START — LAND

| **F/O** | ***CAPTAIN*** |
| --- | --- |
| **OIL PRESSURE** | *GREEN & STABLE* |
| **HYDRAULIC PRESSURE** | *800 – 1000 PSI* |
| **BOOST PUMPS** | *OFF* |
| **CARB HEAT** | *AS REQUIRED* |
| ***APU** | *OFF* - BEFORE GEN TURNED "ON"* |
| **GENERATORS** | *ON* |
| **INVERTER** | *ON* |
| **RADIO MASTER** | *ON* |
| **STATIC SOURCE** | *NORMAL* |
| **SUCTION** | *4.0-5.0 inches* |
| **FLIGHT INSTRUMENTS** | *RIGHT / LEFT* |
| **CLOCK** | *SET* |
| **GYROS &COMPASS** | *SET* |
| **RADIOS &NAV** | *TUNED/SET/IDENTIFIED* |

### e. TAXI CHECKS — LAND

| **F/O** | **CAPTAIN** |
| --- | --- |
| **ALTIMETER** | *SET RIGHT / LEFT* |
| **BRAKES** | *CHECK RIGHT / LEFT* |
| **ENGINE INSTRUMENT** | *GREEN & STABLE* |
| **TRIMS** | *3 SET* |

## OPERATING PROCEDURES

f. **ENGINE RUN-UP** **LAND**

| ***F/O*** | ***CAPTAIN*** |
|---|---|
| **BRAKES ..................................................................** | *PARK-BRAKE SET* |
| **MIXTURE ................................................................** | *AUTO RICH* |
| **PROPELLER PITCH ...............................................** | *FULL FINE* |
| **THROTTLES ..........................................................** | *1000 RPM* |
| **DEAD MAGNETO CHECK .....................................** | *LH &RH* |
| **MIN TEMPS (Taxi & Run- up) ...............................** | *40C OIL / 120C CHT* |
| **RH THROTTLE ......................................................** | *1700 RPM* |
| **HYDRAULIC PRESSURE .......................................** | *800-1000 PSI* |
| **RH CARB HEAT .....................................................** | *CHECKED & COLD* |
| **RH PROP PITCH ..** (1 x 1450 rpm 2 x 1200 rpm) **....** | *FULL COURSE X 2* |
| **GENERATOR AMPS & VOLTS ..............................** | *CHARGING XX VOLTS* |
| **RH FEATHER CHECK ............................................** | *MAX 200 RPM DROP* |
| **AMP LOAD ON FEATHER CHECK ........................** | *CONFIRM* |
| **MAGNETO FIELD BAROMETRIC CHECK ............** | *XX.XX INCHES SET* |
| **REFERENCE RPM .................................................** | *MAX 100 RPM DROP* |
| **RH RPM ...................................................................** | *1000* |

**LH ENGINE RUN-UP – AS PER RH ENGINE**

## OPERATING PROCEDURES

### g. BEFORE TAKE-OFF CHECKS — LAND

| F/O | CAPTAIN |
|---|---|
| **DOORS-HATCHES-EXITS** | *SECURE* |
| **MIXTURES** | *AUTO RICH* |
| **FUEL SELECTORS** | *RT on RT / LT on LT* |
| **PROPS** | *FULL FINE* |
| **THROTTLE FRICTION** | *SET* |
| **IGNITION** | *BOTH ON* |
| **CARB HEAT** | *COLD or AS REQ'D* |
| **HYDRAULICS** | *800-1000 PSI* |
| **TEMPS & PRESS** | *GREEN & STABLE* |
| **DEPARTURE BRIEFING** | *COMPLETED* |
| **RADIOS & NAV** | *SET FOR DEPARTURE* |

### h. LINE-UP CHECKS — LAND

| F/O | CAPTAIN |
|---|---|
| **BOOST PUMPS** | *BOTH ON* |
| **COWL FLAPS** | *TRAIL - 1/3* |
| **PITOT HEAT** | *AS REQ'D* |
| **LANDING & STROBE LIGHTS** | *AS REQ'D* |
| **TRANSPONDER** | *SET* |
| **THROTTLE FRICTION** | *SET* |
| **RUDDER LOCK** | *OFF & SECURE* |
| **FLIGHT CONTROLS** | *FREE TOP & BOTTOM* |

## OPERATING PROCEDURES

### i. AFTER TAKE-OFF CHECKS LAND

| F/O | CAPTAIN |
|---|---|
| **LANDING GEAR** | *UP & LOCKED* |
| **FUEL BOOST PUMPS** | *OFF* |
| **TEMPS & PRESS** | *GREEN & STABLE* |
| **COWL FLAPS** | *AS REQ'D* |
| **POWER** | *SET* |
| **ENGINES** | *CLEAN RT - LEFT* |

### j. CRUISE CHECKS LAND

| F/O | CAPTAIN |
|---|---|
| **CRUISE POWER** | *SET* |
| **ALTIMETERS** | *SET RIGHT / LEFT* |
| **TEMP'S & PRESS** | *GREEN & STABLE* |
| **RADIOS** | *AS REQ'D* |
| **CARB HEAT** | *AS REQ'D* |
| **MIXTURES** | *AUTO LEAN – Maintain 200° C* |
| ***TO MAINTAIN 200° C CHT OR LESS*** | |
| **COWL FLAPS** | *AS REQ'D* |
| **GENERATORS** | *CHARGING* |
| **LIGHTS / STROBES** | *AS REQ'D* |
| **ENGINES** | *CLEAN RIGHT / LEFT* |

**OPERATING PROCEDURES**

k. **IN-RANGE / DESCENT CHECKS** **LAND**

| **F/O** | **CAPTAIN** |
|---|---|
| **ALTIMETER** | *SET RIGHT / LEFT* |
| **MIXTURES** | *AUTO RICH* |
| **COWL FLAPS** | *AS REQ'D* |
| **CARB HEAT** | *AS REQ'D* |
| **LIGHTS & STROBES** | *AS REQ'D* |
| **TEMPS & PRESS** | *GREEN & STABLE* |
| **BRIEFING** | *COMPLETED* |
| **RADIOS & NAV** | *CROSS CHECKED* |
| **FUEL SELECTORS** | *LT on LT / RT on RT* |

l. **BEFORE LANDING CHECKS** **LAND**

| **F/O** | **CAPTAIN / F/O** |
|---|---|
| **** LANDING GEAR ........................................** | *SELECTED* |
| **LANDING GEAR ......…………………………** | *CONFIRMED LIGHTS & VISUAL* |
| **HYDRAULIC PRESSURE ............................** | *800 – 1000 psi* |
| **BRAKES .......................................................** | *CHECKED & PARK-BRAKE OFF* |
| **FUEL BOOST PUMPS ..................................** | *TWO ON & CHECKED* |
| **FLOATS .........................................................** | *UP* |
| **COWL FLAPS ................................................** | *AS REQUIRED* |
| **MIXTURES ....................................................** | *AUTO RICH* |
| **PROPELLER PITCH .....................................** | *2300 RPM* |
| **CARB HEAT ………...........................…………** | *COLD* |
| **PROP PITCH ……........................…………...** | *FULL FINE* |

**CAUTION** ** After GEAR DOWN has been selected ***WAIT*** for the Gear to actually be ***DOWN and LOCKED*** before continuing with Checklist

**OPERATING PROCEDURES**

m. **AFTER LANDING CHECKS** **LAND**

| **F/O** | ***CAPTAIN* / F/O** |
|---|---|
| **RUDDER LOCK ...............................................** | *SET & LOCKED* |
| **FUEL BOOST PUMPS .......................................** | *BOTH OFF* |
| **COWL FLAPS ...................................................** | *OPEN* |
| **CARB HEAT .....................................................** | *AS REQ'D* |
| **TRANSPONDER ...............................................** | *STANDBY* |
| **LIGHTS & STROBES .......................................** | *AS REQ'D* |
| **PITOT HEAT .....................................................** | *OFF* |

## OPERATING PROCEDURES

### n. SHUTDOWN CHECKS — LAND

| F/O | CAPTAIN / F/O |
|---|---|
| **PARK-BRAKE** | *SET* |
| **FLIGHT PLAN** | *CLOSED* |
| **INVERTER** | *OFF* |
| **THROTTLES** | *700 RPM* |
| **LIVE MAG CHECK** | *LH & RH & MASTER IGNITION* |
| **MIXTURES** | *ICO - Idle Mixture Check* |
| **MAGNETOS** | *L & R & MASTER OFF* |
| **PROP PITCH** | *FULL FINE* |
| **THROTTLES** | *OPEN* |
| **BEACON** | *OFF* |
| **TRANSPONDER** | *OFF* |
| **GENERATORS** | *OFF* |
| **RADIO MASTER** | *OFF* |
| **BATTERY MASTER** | *OFF* |

## AFTER FLIGHT CHECKS
## LAND

## CAPTAIN AND DESIGNATED PERSONNEL

| | |
|---|---|
| **WHEEL CHOCKS ..............................................** | *INSTALLED* |
| **GEAR PINS ........................................................** | *INSTALLED* |
| **INTERNAL CONTROL LOCK ...........................** | *INSTALLED* |
| **EXTERNAL CONTROL LOCKS .........................** | *AS REQUIRED* |
| **COWL FLAPS .....................................................** | *CHT BELOW 50° C OR* |
| | *WAIT 15 MINUTES* |
| | *THEN CLOSE* |
| **POST FLIGHT WALK AROUND .......................** | *COMPLETED* |
| **HULL PLUGS ....**........................................ | *14 OUT – DRAIN HULL* |

**SNAGS ??**

| | |
|---|---|
| **AIRCRAFT SECURE** | *ENGINES /COCKPIT/DOORS* |
| **LOG BOOK ENTRIES** | *COMPLETED* |

# Water

# CHECKLIST

## OPERATING PROCEDURES

CAUTION ** *Fuel and Oil levels will show false amounts with wing and tail low on water.*

CAUTION *** For water work checking fluids with either wing or tail low use the Land / Sea indicators on the Oil Dip Stick. ***

## OPERATING PROCEDURES

### 1.28 WATER CHECKLISTS

#### a. BEFORE WATER OPERATIONS WATER

| | |
|---|---|
| **CREW RATING.......................................................** | APPROPRIATE |
| **LANDING APPROVAL..........................................** | OBTAINED |
| **WATER CHARTS.................................................** | AVAILABLE |
| **HULL PLUGS (14)................................................** | IN |
| **NOSE DOORS.......................................................** | CLOSED-VISUAL |
| | PINS LOCKED |
| | CHECK BEFORE LANDING |
| **RADIO CALL.........................................................** | AIR OR MARINE |
| **WATER LANDING AREA......................................** | ASSESS |
| **ACCESSMENT........................................................** | SURFACE CONDITIONS |
| | WAVE HEIGHT LESS THAN 2 FT |
| | GLASSY WATER |
| | WIND DIRECTION/ STRENGTH |
| | APPROACH OBSTACLES |
| | DEPTH / ESCAPE / OVERSHOOT |
| | WATER OBSTACLES |
| | (SURFACE AND BELOW) |
| | BEACHING AREA |
| | OTHER TRAFFIC |
| | (AIR AND MARINE) |
| **OPERATING LENGTH...........................................** | ACCESS AVAILABILITY |
| **CIRCUIT DIRECTION............................................** | DECIDE |
| **GO or NO GO........................................................** | DECIDE |
| **EMERGENCIES......................................................** | ENG FAILURE < 80 KTS |
| | OTHER |

## OPERATING PROCEDURES

### b. BEFORE FLIGHT CHECKS WATER

| ***CAPTAIN*** | ***F/O*** |
|---|---|
| **EMERGENCY BREIFING .........................** | *COMPLETE* |
| **LOG BOOK .........................................** | *ON BOARD* |
| **FLIGHT PLAN – WT & BALANCE .................** | *FILED* |
| **EXTERNAL CHECKS ....................................** | *COMPLETED* |
| **FLIGHT CONTROLS .....................................** | *FULL & CORRECT* |
| **CIRCUIT BREAKERS ...............................** | *IN* |
| **LDG & STROBE LGTS ............................** | *OFF* |
| **GENERATORS .......................................** | *OFF* |
| **RADIO MASTER ...........................................** | *OFF* |
| **INVERTER ....................................................** | *OFF* |
| **PITOT HEAT .................................................** | *OFF* |
| **FUEL SELECTORS ......................................** | *RT on RT / LT on LT* |
| **WATER BOMB MASTER ..............................** | *OFF* |
| **FLOAT SWITCH ...........................................** | *NEUTRAL* |
| **IGNITION MASTER .......................................** | *OFF* |
| **GEAR SELECTOR .........................................** | *DOWN* |
| **GEAR ISOLATION VALVES ..........................** | *OPEN* |
| **BATTERY MASTER ......................................** | *ON* |
| **COWL GILLS ................................................** | *OPEN* |
| **CARB HEAT ..................................................** | *COLD* |
| **AUX HYD PUMP ............................................** | *ON & PRESSURE UP* |
| **WARNING & FIRE LIGHTS ............................** | *CHECKED* |
| **FIRE WARNING LIGHTS ...............................** | *CHECKED* |
| **NOSE DOOR LIGHTS ....................................** | *CHECKED* |
| **BATTERY MASTER .......................................** | *OFF* |

## OPERATING PROCEDURES

### c. BEFORE START — WATER

| CAPTAIN | F/O |
|---|---|
| **PASSENGER BREIFING ................................** | COMPLETED |
| **SEATS, BELTS, PEDALS ...............................** | *ADJUSTED* |
| **DOORS, HATCHES & EXITS .........................** | *CLOSED* |
| **MAPS & LOG BOOK ......................................** | *CHECKED* |
| **EXTERNAL CHECKS .....................................** | *COMPLETED* |
| **LOCKS, CHOCKS, LADDER & PINS ............** | *STOWED* |
| **BLISTER, SIDE & TOP EXITS ........................** | *CLOSED* |
| **FUEL, OIL, HYD LEVELS ..............................** | *CHECKED* |
| **FUEL SELECTORS ........................................** | *RT ON RT - LT ON LT* |
| **COWL FLAPS .................................................** | *SET* |
| **THROTTLES ..................................................** | *SET* |
| **PROPS ...........................................................** | *FULL FINE* |
| **MIXTURE ........................................................** | *ICO* |
| **CARBURETOR HEAT ....................................** | *COLD* |
| **BATTERY MASTER .......................................** | *ON* |
| **BEACON ........................................................** | *ON* |
| **RUDDER ........................................................** | *UNLOCKED* |
| **GEAR ..…………………………………….** | *UP* |
| **APU ...............................................................** | *ON & START* |
| **IGNITION MASTER .......................................** | *ON* |

**CAUTION** *****PLAN ENGINE START ACCORDING TO INTENDED DEPARTURE - SITUATIONAL AWARENESS – WIND –HAZARDS - SHORELINE***

## OPERATING PROCEDURES

### d. ENGINE STARTING **WATER**

***CAPTAIN***

***PRIME SECOND ENGINE FIRST!*** **…. THEN BEGIN First Engine Start**

Priming the Second engine first then starting the first makes the second easier and quicker to start

**FIRST ENGINE**

**FIRST ENGINE PROPELLER** ........................................................... *CLEAR*

**FIRST ENGINE FUEL BOOST PUMP** ............................................... *ON*

**FIRST ENGINE STARTER** ................................................................. *ENGAGE*

**FIRST ENGINE IGN *(After 14 blades cold, 7 hot)* …………………....** *BOTH*

**FIRST ENGINE FUEL PRIMER** ….................................................... *AS REQ'D*

**FIRST ENGINE MIXTURE(*When stable with prime @ 500 RPM)*** *AUTO RICH*

***Release primer when engine begins to bog.***

***Stabilize RPM between 600 – 800 RPM***

**FIRST ENGINE OIL PRESSURE** ....................................................... *GREEN & STABLE*

**HYDRAULIC PRESSURE** .................................................................. *800 – 1000 psi*

**FIRST ENGINE FUEL BOOST PUMP** ............................................... *OFF &STABLE*

**FIRST ENGINE CARB HEAT** ............................................................ *AS REQ'D*

**SECOND ENGINE ...................... REPEAT AS PER FIRST ENGINE**

**LIMITATIONS:**

**STARTER - 30 Seconds continuous.**

**OIL PRESSURE: Shut down engine if no indication within shows within 10 seconds**

## OPERATING PROCEDURES

### e. AFTER START — WATER

| ***F/O*** | ***CAPTAIN*** |
|---|---|
| ***APU** ........................................ | *OFF** - ***Before Gen Turned "ON"*** |
| **GENERATORS** ........................................ | *ON* |
| **INVERTER** ........................................ | *ON* |
| **STATIC SOURCE** ........................................ | *NORMAL* |
| **SUCTION** ........................................ | *4.0-5.0 inches* |
| **FLIGHT INSTRUMENTS** ........................................ | *RIGHT / LEFT* |
| **CLOCK** ........................................ | *SET* |
| **GYROS & COMPASS** ........................................ | *SET* |
| **RADIOS & NAV** ........................................ | *TUNED / SET / IDENTIFIED* |

## OPERATING PROCEDURES

### f. TAXI CHECKS — WATER

| F/ O | CAPTAIN |
|---|---|
| **SITUATIONAL AWARENESS ..................** | *WIND, WATER, HAZARDS* |
| **ALTIMETERS ..............................................** | *SET RIGHT / LEFT* |
| **FLT INSTRUMENTS ....................................** | *CHECK RIGHT / LEFT* |
| **ENG INSTRUMENTS ..................................** | *GREEN & STABLE* |
| **ATIS / CLEARANCES ................................** | *RECEIVED* |

### g. ENGINE RUN-UP — WATER

| F/O | CAPTAIN |
|---|---|
| **MIXTURES ..................................................** | *AUTO RICH* |
| **PROP PITCH ..............................................** | *FULL FINE* |
| **THROTTLES ..............................................** | *1000 RPM* |
| **DEAD MAG CHECK ..................................** | *LH & RH* |
| **MIN TEMPS (Taxi & Run up) ...................** | 40c OIL / 120c CHT |
| **RH THROTTLE ..........................................** | *1700 RPM* |
| **HYDRAULIC PRESSURE .........................** | *800-1000 PSI* |
| **RH CARB HEAT .......................................** | *CHK'D & COLD* |
| **RH PROP PITCH ......................................** | *FULL COARSE X2* |
| **GENERATOR AMPS &VOLTS ...............** | *CHARGING xx VOLTS* |
| **RH FEATHER CHECK .............................** | *MAX.200 RPM DROP* |
| **AMP LOAD ON FEATHER CHECK ........** | *CONFIRM?* |
| **MAG FIELD BARO CHECK xx.xx in ........** | *MAX 100 RPM DROP* |
| **REF RPM .............. xx.xx ..........................** | *NOTED* |
| **RH RPM .......................................................** | *1000* |

***SECOND ENGINE RUN UP - AS PER FIRST ENGINE***

## OPERATING PROCEDURES

### h. BEFORE TAKE-OFF CHECKS — WATER

| F/O | CAPTAIN |
|---|---|
| **DOORS, HATCHES & EXITS** ..................... | *SECURED* |
| **TRIMS** ........................................................ | *3 SET* |
| **MIXTURES** ................................................. | *AUTO RICH* |
| **FUEL SELECTORS** ................................... | *RT on RT - LT on LT* |
| **THROTTLE FRICTION** ............………… | *SET* |
| **PROPELLERS** ........................................... | *FULL FINE* |
| **IGNITION** .................................................. | *BOTH ON* |
| **CARB HEAT** .............................................. | *AS REQ'D* |
| **HYDRAULICS** ........................................... | *800-1000 psi* |
| **TEMPS & PRESS** ....................................... | *GREEN & STABLE* |
| **TAKE-OFF BRIEFING** ................................ | *COMPLETED* |
| **RADIOS & NAV** .......................................... | SET FOR DEPARTURE |
| **FLOATS** ……………….............…..……... | *DOWN & LOCKED* |
| **LANDING GEAR** …...............…………..… | *UP & LOCKED* |
| **NOSE GEAR DOORS** …...................…….. | *CONFIRM CLOSED* |
| **NOSE GEAR DOOR PINS** .........…..……… | *CONFIRM IN* |

### i. LINE-UP — WATER

| F/O | CAPTAIN |
|---|---|
| **BOOST PUMPS** ........................................ | *ON* |
| **COWL FLAPS** ............................................ | *TRAIL – 1/3* |
| **PITOT HEAT** ............................................. | *AS REQ'D* |
| **LANDING & STROBE LIGHTS** ................. | *ON* |
| **TRANSPONDER** ...................................... | *ON* |
| **RUDDER LOCK** ....................................... | *OFF* |
| **FLIGHT CONTROLS** ................................ | *CHECKED FREE* |
| **TAKE-OFF AREA** ..................................... | *CLEAR* |

## OPERATING PROCEDURES

### j. AFTER TAKE-OFF — WATER

| **F/O** | **CAPTAIN** |
|---|---|
| **FLOATS** ........................................................ | *UP - LOCKED* |
| **BOOST PUMPS** .......................................... | *OFF* |
| **TEMPS & PRESS** ...................................... | *CHECKED* |
| **COWL FLAPS** .............................................. | *AS REQ'D* |
| **POWER** ........................................................ | *SET* |
| **ENGINE** ........................................................ | *CLEAN RT / LT* |

### k. CRUISE CHECK — WATER

| **F/O** | **CAPTAIN** |
|---|---|
| **CRUISE POWER** .......................................... | SET |
| **ALTIMETERS** ................................................ | SET LT & RT |
| **TEMPS & PRESS** ......................................... | GREEN & STABLE |
| **RADIO'S** ....................................................... | AS REQUIRED |
| **CARB HEAT** .................................................. | AS REQ'D |
| **MIXTURES** ................................................... | AUTO LEAN |
| ***TO MAINTAIN CHT 200C or LESS*** | |
| **COWL FLAPS** .............................................. | AS REQ'D |
| **GENERATORS** ............................................ | CHARGING |
| **LIGHTS & STROBES** ................................... | AS REQUIRED |
| **ENGINES** ...................................................... | CLEAN RIGHT / LEFT |

## OPERATING PROCEDURES

### l. IN-RANGE — WATER

| F/O | CAPTAIN |
|---|---|
| **ALTIMETERS** | SET LT & RT |
| **MIXTURES** | *AUTO RICH* |
| **COWL FLAPS** | *AS REQUIRED* |
| **CARB HEAT** | *AS REQUIRED* |
| **LANDING & STROBE LIGHTS** | *AS REQUIRED* |
| **TEMPS & PRESSURES** | *GREEN & STABLE* |
| **RADIOS & NAV** | *CROSS CHECKED* |
| **FUEL SELECTORS** | *RT on RT - LT on LT* |

### m. BEFORE LANDING — WATER

| F/O | CAPTAIN |
|---|---|
| **SURFACE HAZARD CHECK** | *COMPLETE* |
| **WIND DIRECTION / SPEED** | *CHECKED / DIR* |
| **WATER LANDING BRIEFING** | *COMPLETE* |
| ***FLOATS** | *DOWN & LOCKED* |
| **LANDING GEAR** | *UP / LOCKED* |
| **NOSE DOORS** | *CLOSED & LOCKED* |
| **NOSE DOOR PINS** | *CONFIRM PINS - IN* |
| **HYDRAULICS** | *800 – 1000 PSI* |
| **FUEL BOOST PUMPS** | *ON* |
| **COWL FLAPS** | *AS REQ'D* |
| **MIXTURE** | *AUTO RICH* |
| **PROPELLERS** | *2300 RPM* |

**NOTE: * For a Water Touch and Go Floats can remain UP**

## .OPERATING PROCEDURES

### n. AFTER LANDING — WATER

| F/O | CAPTAIN |
|---|---|
| **RUDDER LOCK** | *UNLOCKED* |
| **LANDING GEAR** | *UP/DOWN (AS REQUIRED)* |
| **FUEL BOOST PUMPS** | *TWO OFF* |
| **COWL FLAPS** | *OPEN* |
| **TRANSPONDER** | *STANDBY* |
| **LIGHTS & STROBES** | *AS REQUIRED* |
| **PITOT HEAT** | *OFF* |

### o. SHUTDOWN — WATER

| F/O | CAPTAIN |
|---|---|
| **PLANE** | *SECURED* |
| **FLIGHT PLAN** | *CLOSED* |
| **INVERTER** | *OFF* |
| **THROTTLES** | *700 RPM* |
| **LIVE MAGNETO CHECK** | *LH / RH & MASTER IGN OFF* |
| **MIXTURES ...IDLE MIXTURE CHECK** | *ICO* |
| **MAGS** | *L & R & MASTER IGN OFF* |
| **PROPS** | *FULL FINE* |
| **THROTTLES** | *OPEN* |
| **ROTATING BEACON** | *OFF* |
| **TRANSPONDER** | *OFF* |
| **GENERATORS** | *OFF* |
| **RADIO MASTER** | *OFF* |
| **BATTERY MASTER** | *OFF* |
| **MOORING** | *CHECKED* |
| **CONTROL LOCK** | *ON* |
| **EXHAUST / ENGINE COVERS** | *AS REQ'D* |

b. **AFTER FLIGHT CHECKS** **WATER**

**CAPTAIN and designated PERSONNEL**

| | |
|---|---|
| **ANCHOR / BUOY ........................................** | *INSTALLED / ATTACHED* |
| **INTERNAL CONTROL LOCKS ...................** | *INSTALLED* |
| **EXTERNAL CONTROL LOCKS ..................** | *AS REQUIRED* |
| **COWL FLAPS .............................................** | *CHT BELOW 50° C or WAIT 15 MINUTES THEN CLOSE* |

**SNAGS??**

| | |
|---|---|
| **AIRCRAFT SECURE..................................** | *ENGINES / COCKPIT / DOORS* |
| **LOGBOOK ENTRIES ..................................** | *COMPLETED* |
| | *OFF* |
| **BATTERY MASTER ...................................** | *CHECKED* |
| **EXHAUST / ENGINE COVERS ....................** | *AS REQUIRED* |

**Forest Fire Suppression Checklist**

## OPERATING PROCEDURES

CAUTION **When being operated as a Fire Fighter, the aircraft is restricted to only essential crew for the operation.

CAUTION: ***Before Starting***

1. Water Master Switch must be OFF
2. Water Hydraulic Isolation Valve must be OFF
3. Ensure Stiff Leg Safety Bracket is removed
4. Probe safety bracket is removed

Start engines as per normal Land or Water Engine Starting Procedures.
Pre Flight Checks (Engines Idling)

## OPERATING PROCEDURES

## 1.29 FIRE FIGHTING CHECKLISTS

### a. BEFORE FLIGHT CHECKS

### FIRE FIGHTING LAND

| ***CAPTAIN*** | ***F/O*** |
|---|---|
| **EXTERNAL CHECKS ....................……..…..** | *COMPLETE* |
| **FLT CONTROLS ...…...................................….** | *FULL & CORRECT* |
| **LOG BOOK ………….....................………….....** | *ON BOARD* |
| **CIRCUIT BREAKERS ……….............................** | *IN* |
| **LDG & STROBE LGTS ……........................…..** | *OFF* |
| **GENERATORS .........…….……...........………..** | *OFF* |
| **RADIO MASTER ...........................................** | *OFF* |
| **INVERTER ...................................................** | *OFF* |
| **PITOT HEAT ................................................** | *OFF* |
| **FUEL SELECTORS .......................................** | *RT on RT-LT on LT* |
| **WATER BOMB MASTER ...............................** | *OFF* |
| **FLOAT SWITCH ............................................** | *NEUTRAL* |
| **IGNITION MASTER .......................................** | *OFF* |
| **GEAR SELECTOR ..........................................** | *DOWN* |
| **GEAR ISOLATION VALVES ...........................** | *OPEN* |
| **BATTERY MASTER ......................................** | *ON* |
| **COWL GILLS ................................................** | *OPEN* |
| **CARB HEAT .................................................** | *COLD* |
| **AUX HYD PUMP .........................................** | *ON & PRESS UP* |
| **WARNING LIGHTS ......................................** | *CHECKED* |
| **FIRE WARNING LIGHTS ................................** | *CHECKED* |
| **NOSE DOOR LIGHTS ....................................** | *CHECKED* |
| **BATTERY MASTER .......................................** | *OFF* |
| **FLIGHT PLAN ................................................** | *FILED* |

**OPERATING PROCEDURES**

b. **BEFORE START CHECKS**

**FIRE FIGHTING LAND**

| **F/O** | ***CAPTAIN*** |
|---|---|
| **PAX BRIEF ....................................................** | *COMPLETE* |
| **BATTERY MASTER ......................................** | *ON* |
| **RADIO MASTER .......................................** | *ON* |
| **VOX ..............................................................** | *SET* |
| **BEFORE FLT INSPECTION .........................** | *COMPLETED* |
| **PARK BRAKE .............................................** | *SET* |
| **SEATS, BELTS, PEDALS ............................** | *ADJUSTED* |
| **DOORS, HATCHES, BLISTERS, EXITS ......** | *SECURED* |
| **LOCKS, CHOCKS, LADDER, POGO ...........** | *STOWED* |
| **FLIGHT PLAN, W&B ..................................** | *COMPLETED* |
| **FUEL, OIL, HYDRAULICS ...........................** | (*STATE QUANTITY*) |
| **STATIC MAN.PRESSURE ...........................** | *NOTED XX.XX”* |
| **THROTTLES ..............................................** | *SET (1/4”)* |
| **PROP PITCH ..................................................** | *FULL FINE* |
| **MIXTURES ..................................................** | *ICO* |
| **BEACON …...................................................** | *ON* |
| **APU …...........................................................** | *ON & START* |
| **IGNITION MASTER ..................................** | *ON* |
| **START ENGINES .......................................** | *RH #1. LH #2* |

**OPERATING PROCEDURES**

b. **ENGINE STARTING**

**FIRE FIGHTING LAND**

***CAPTAIN***

**RH ENGINE**

| | |
|---|---|
| **RH PROPELLER ...............................................................** | *CLEAR* |
| **RH FUEL BOOST PUMP ...................................................** | *ON* |
| **RH STARTER .....................................................................** | *ENGAGE* |
| **RH IGNITION *(Count 14 blades cold, 7 hot)*..................** | *BOTH* |
| **RH FUEL PRIMER .. ..........................................................** | *AS REQ'D* |
| **RH MIXTURE(*When stable with prime @ 500 RPM)*......** | *AUTO RICH* |

***Release primer when engine begins to bog.***

***Stabilize RPM between 600 – 800 RPM***

| | |
|---|---|
| **RH OIL PRESSURE ..........................................................** | *GREEN & STABLE* |
| **HYDRAULIC PRESSURE ...................................................** | *800 – 1000 psi* |
| **RH FUEL BOOST PUMP ...................................................** | *OFF &STABLE* |
| **RH CARB HEAT ...............................................................** | *AS REQ'D* |

**LH ENGINE ....................................  REPEAT AS PER RH ENGINE**

**LIMITATIONS:**

**STARTER - 30 Seconds continuous.**
**2 min cool down before attempting restart.**

**OIL PRESSURE: Shut down engine if no indication within shows within 10 seconds**

## OPERATING PROCEDURES

### c. AFTER START CHECKS

### FIRE FIGHTING LAND

| **F/O** | ***CAPTAIN*** |
|---|---|
| ***APU ..........................................................................** | *OFF** |
| **GENERATORS ..................................................................** | *ON* |
| **INVERTER ........................................................................** | *ON* |
| **STATIC SOURCE .............................................................** | *NORMAL* |
| **SUCTION .........................................................................** | *4.0-5.0 inches* |
| **FLIGHT INSTRUMENTS ..................................................** | *RIGHT / LEFT* |
| **CLOCK ............................................................................** | *SET* |
| **GYROS & COMPASS ......................................................** | *SET* |
| **RADIOS & NAV ................................................................** | *TUNED/SET/IDENTIFIED* |
| **WATER BONBING TANK MASTER ..................................** | *ON* |
| **WATER BOMBING LIGHTS .............................................** | *CHECKED* |
| **WATER BOMBING ISOLATION VALVE ..........................** | *OPEN* |
| **ARMING SWITCH ............................................................** | *ON – Observe Amber light* |
| **STARBOARD ENGINE .....................................................** | *SLOW IDLE* |
| ***BOTH TANKS ................................................................** | *SELECT DUMP* |

***Observe Hydraulic pressure loss**, then as doors close observe and note pressure build-up. Note exact pressure of door latching. Pressure will fluctuate for each door and the latching sound heard.

| | |
|---|---|
| **LATCHING HYDRAULIC PRESSURE ............................** | *BETWEEN 500 AND 700 PSI* |
| **OPERATE PROBE DOWN AND UP ...............................** | *OBSERVE LIGHTS* |
| **EMERGENCY DUMP LEVER ..........................................** | *CYCLED* |
| **ALL WATER SYSTEM SWITCHES AND VALVES .......** | *OFF – OBSERVE DOOR CLOSING LIGHTS* |
| **WATER BOMBING MASTER ..........................................** | *OFF* |

**CAUTION** ***** Turn APU OFF before turning Generators ON***

## OPERATING PROCEDURES

### d. TAXI CHECKS

### FIRE FIGHTING LAND

| F/ O | CAPTAIN |
|---|---|
| **ALTIMETERS** .................................... | *SET RIGHT/ LEFT* |
| **BRAKES** ............................................ | *CHECK RIGHT/ LEFT* |
| **FLT INSTRUMENTS** .......................... | *CHECK RIGHT/ LEFT* |
| **ENG INSTRUMENTS** ........................ | *GREEN & STABLE* |
| **ATIS / CLEARANCES** ........................ | *RECEIVED* |

## OPERATING PROCEDURES

### e. ENGINE RUN-UP

### FIRE FIGHTING LAND

| **F/O** | ***CAPTAIN*** |
|---|---|
| **BRAKES ............................................................** | *PARK-BRAKE SET* |
| **MIXTURES ........................................................** | *AUTO RICH* |
| **PROP PITCH ......................................................** | *FULL FINE* |
| **THROTTLES ......................................................** | *1000 RPM* |
| **DEAD MAG CHECK ..........................................** | *LH & RH* |
| **MIN TEMPS (Taxi & Run up) .............................** | *40c OIL / 120c CHT* |
| **RH THROTTLE ..................................................** | *1700 RPM* |
| **HYDRAULIC PRESSURE ..................................** | *800-1000 PSI* |
| **RH CARB HEAT .................................................** | *CHK'D & COLD* |
| **RH PROP PITCH ................................................** | *FULL COARSE X2* |
| **GENERATOR AMPS & VOLTS ..........................** | *CHARGING xx VOLTS* |
| **RH FEATHER CHECK ........................................** | *MAX.200 RPM DROP* |
| **AMP LOAD ON FEATHER CHECK ....................** | *CONFIRM?* |
| **MAG FIELD BARO CHECK xx.xx inches ........** | *MAX 100 RPM DROP* |
| **REF RPM .............................xx.xx.......................** | *Noted* |
| **RH RPM ..............................................................** | *1000* |

***LH ENGINE RUN UP - AS PER RH ENGINE***

**CAUTION** **Write down Reference Check

## OPERATING PROCEDURES

### f. BEFORE TAKE-OFF CHECKS

### FIRE FIGHTING LAND

| F/O | CAPTAIN |
|---|---|
| **DOORS, HATCHES & EXITS** | *SECURED* |
| **TRIMS** | *3 SET* |
| **MIXTURES** | *AUTO RICH* |
| **FUEL SELECTORS** | *RT on RT - LT on LT* |
| **PROPS** | *FULL FINE* |
| **THROTTLE FRICTION** | *SET* |
| **IGNITION** | *BOTH ON* |
| **CARB HEAT** | *COLD or AS REQ'D* |
| **HYDRAULICS** | *800-1000 psi* |
| **TEMPS & PRESS** | *GREEN & STABLE* |
| **CYLINDER HEAD TEMP** | *150-200c* |
| **TAKE-OFF BRIEFING** | *COMPLETED* |
| **RADIOS & NAV** | *SET FOR DEPARTURE* |

## OPERATING PROCEDURES

### g. LINE-UP CHECKS

### FIRE FIGHTING LAND

| F/O | CAPTAIN / F/O |
|---|---|
| **BOOST PUMPS** ........................................ | *BOTH ON* |
| **COWL FLAPS** ........................................ | *TRAIL- 1/3* |
| **PITOT HEAT** ........................................ | *AS REQ'D* |
| **LANDING & STROBE LIGHTS**............................ | *AS REQ'D* |
| **TRANSPONDER** ........................................ | *SET* |
| **THROTTLE FRICTION** ................................ | *SET* |
| **RUDDER LOCK** ........................................ | *OFF & SECURE* |
| **FLT CONTROLS** ........................................ | *FREE TOP & BOTTOM* |

## OPERATING PROCEDURES

### h. AFTER TAKE-OFF

**FIRE FIGHTING LAND**

| F/O | CAPTAIN / F/O |
|---|---|
| **LANDING GEAR ....................................................** | *UP AND LOCKED* |
| **FUEL BOOST PUMPS ...........................................** | *OFF* |
| **TEMPS & PRESS ..................................................** | *GREEN & STABLE* |
| **COWL FLAPS .......................................................** | *AS REQ'D* |
| **POWER ………………………………………………..** | *SET* |
| **ENGINES ……………………………………………….** | *CLEAN RIGHT / LEFT* |

### i. CRUISE CHECKS

**FIRE FIGHTING LAND**

| F/O | CAPTAIN / F/O |
|---|---|
| **CRUISE POWER ......................................................** | *SET* |
| **ALTIMETERS ..........................................................** | *SET RIGHT / LEFT* |
| **TEMPS & PRESS ....................................................** | *GREEN & STABLE* |
| **RADIOS ..................................................................** | *AS REQ'D* |
| **CARB HEAT ..........................................................** | *AS REQ'D* |
| **MIXTURE .............................................................** | *AUTO LEAN* |
| ***TO MAINTAIN 200° C CHT OR LESS*** | |
| **COWL FLAPS .........................................................** | *AS REQ'D* |
| **GENERATORS ........................................................** | *CHARGING* |
| **LIGHTS / STROBES ................................................** | *AS REQ'D* |
| **ENGINES ................................................................** | *CLEAN RIGHT / LEFT* |

## OPERATING PROCEDURES

### j. BEFORE BOMB CHECKS

**FIRE FIGHTING LAND**

| F/O | CAPTAIN / F/O |
|---|---|
| **ISOLATION VALVE ................................................** | *OPEN* |
| **WATER BOMB MASTER .......................................** | *ON* |
| **LIGHTS & STROBES ............................................** | *ON* |
| **BOOST PUMPS ……………………….……………** | *ON* |
| **COWL FLAPS ........................................................** | *AS REQ'D* |
| **CARB HEAT ..........................................................** | *COLD* |
| **MIXTURES ……………………………………………** | *AUTO RICH* |
| **FOAM …………………………………………………..** | *ARM* |
| **BILGE PUMPS ………………………….……………** | *ON* |

## OPERATING PROCEDURES

### k. WATER PICK-UP CHECKS

**FIRE FIGHTING LAND**

| F/O | CAPTAIN / F/O |
|---|---|
| GEAR AND FLOATS ............................................ | *SET* |
| DOOR JACK GEAR & FLOAT LIGHTS ………….... | *SET RIGHT / LEFT* |
| TEMPS & PRESS ................................................. | *GREEN & STABLE* |
| BOOST PUMPS ……………………..……………….. | *ON* |
| ARMING SWITCH ……………………………………. | *OFF* |
| TANK SELECTOR …………………………………… | *BOTH* |
| NOSE DOOR PINS ………………...………………… | *IN* |
| DOORS AND JACKS ……………...………………… | *VISUAL* |
| BRIEFING …………………………….……………… | *COMPLETE* |
| MIXTURE ............................................................ | *AUTO RICH* |
| PROPS ………………………...…………………… | *2300 RPM* |

### l. SHORT FINAL CHECKS

**FIRE FIGHTING LAND**

| F/O | CAPTAIN / F/O |
|---|---|
| PROPS ............................................................ | *FULL FINE* |
| TRIM ....…………………………………………… | *SET* |

## OPERATING PROCEDURES

### m. BOMBING RUN CHECKS

**<u>FIRE FIGHTING LAND</u>**

| **F/O** | ***CAPTAIN* / F/O** |
| --- | --- |
| **FOAM** | *INJECT* |
| **ARMING SWITCH** | *ON* |
| **TANK SELECTOR** | *SET* |
| **HYDRAULIC PRESSURE** | *CHECKED* |
| **PROPS** | *2300 RPM* |

### n. IN-RANGE / DESCENT CHECKS

**<u>FIRE FIGHTING LAND</u>**

| **F/O** | ***CAPTAIN* / F/O** |
| --- | --- |
| **ALTIMETERS** | *SET RIGHT / LEFT* |
| **MIXTURES** | *AUTO RICH* |
| **COWL FLAPS** | *AS REQ'D* |
| **CARB HEAT** | *AS REQ'D* |
| **WATER BOMBING MASTER** | *OFF* |
| **LIGHTS & STROBES** | *AS REQ'D* |
| **TEMPS & PRESS** | *GREEN & STABLE* |
| **BRIEFING** | *COMPLETED* |
| **RADIOS & NAV** | *CROSSCHECKED* |
| **FUEL SELECTORS** | *RT on RT - LT on LT* |

## OPERATING PROCEDURES

o. **BEFORE LANDING CHECKS**

### FIRE FIGHTING LAND

| **F/O** | ***CAPTAIN / F/O*** |
|---|---|
| ****GEAR DOWN ........................................................** | *SELECTED* |
| **LANDING GEAR .....................................................** | *CONFIRMED LIGHTS & VISUAL* |
| **HYDRAULIC PRESS ..............................................** | *800 – 1000 psi* |
| **BRAKES ...................................................................** | *CHECKED &PARK-BRAKE OFF* |
| **FUEL BOOST PUMPS ............................................** | *TWO ON & CHECKED* |
| **FLOATS ....................................................................** | *UP* |
| **COWL FLAPS .........................................................** | *AS REQ'D* |
| **MIXTURES ..............................................................** | *AUTO RICH* |
| **PROP PITCH ...........................................................** | *2300 RPM* |

**CAUTION** ** After GEAR DOWN has been selected WAIT for the Gear to actually be DOWN and Locked before continuing with Checklist

p. **FINAL CHECKS**

### FIRE FIGHTING LAND

| **F/O** | ***CAPTAIN / F/O*** |
|---|---|
| **CARB HEAT ............................................................** | *COLD* |
| **LANDING GEAR .....................................................** | *DOWN & LOCKED* |
| **PROP PITCH ...........................................................** | *FULL FINE* |

## OPERATING PROCEDURES

### q. AFTER LANDING CHECKS

**FIRE FIGHTING LAND**

| **F/O** | ***CAPTAIN / F/O*** |
|---|---|
| **RUDDER LOCK** ...................................................... | *SET & LOCKED* |
| **FUEL BOOST PUMPS** ........................................... | *TWO OFF* |
| **COWL FLAPS** ........................................................ | *OPEN* |
| **CARB HEAT** .......................................................... | *AS REQ'D* |
| **TRANSPONDER** .................................................... | *STANDBY* |
| **LIGHTS & STROBES** ............................................. | *AS REQ'D* |
| **PITOT HEAT** .......................................................... | *OFF* |
| **FLIGHT PLAN** ........................................................ | *CLOSED* |

### r. SHUTDOWN CHECKS

**FIRE FIGHTING LAND**

| **F/O** | ***CAPTAIN*** |
|---|---|
| **PARK-BRAKE** ........................................................ | *SET* |
| **INVERTER** ............................................................... | *OFF* |
| **THROTTLES** ........................................................... | *700 RPM* |
| **LIVE MAG CHECK** ................................................. | *LH/ RH & MASTER IGN* |
| **MIXTURES** ............................................................. | *ICO Idle Mixture Check* |
| **MAGNETOS** ......................................................... | *L&R & MASTER OFF* |
| **PROP PITCH** ......................................................... | *FULL FINE* |
| **THROTTLE** ............................................................ | *OPEN* |
| **BEACON** ................................................................ | *OFF* |
| **GENERATORS** ....................................................... | *OFF* |
| **RADIO MASTER** ..................................................... | *OFF* |
| **BATTERY MASTER** ................................................. | *OFF* |

## OPERATING PROCEDURES

### S. POST FLIGHT CHECKS

### FIRE FIGHTING LAND

**CAPTAIN and designated Personnel**

| | |
|---|---|
| **WHEEL CHOCKS ....................................................** | *INSTALLED* |
| **GEAR PINS ............................................................** | *INSTALLED* |
| **INTERNAL CONTROL LOCK ................................** | *INSTALLED* |
| **EXTERNAL CONTROL LOCKS .............................** | *AS REQ'D* |
| **COWL FLAPS ........................................................** | *CHT BELOW 50c – CLOSED* |
| **POST FLIGHT WALK AROUND ............................** | *COMPLETED* |
| **HULL PLUGS …………………………….………..** | *14 OUT – DRAIN HULL* |

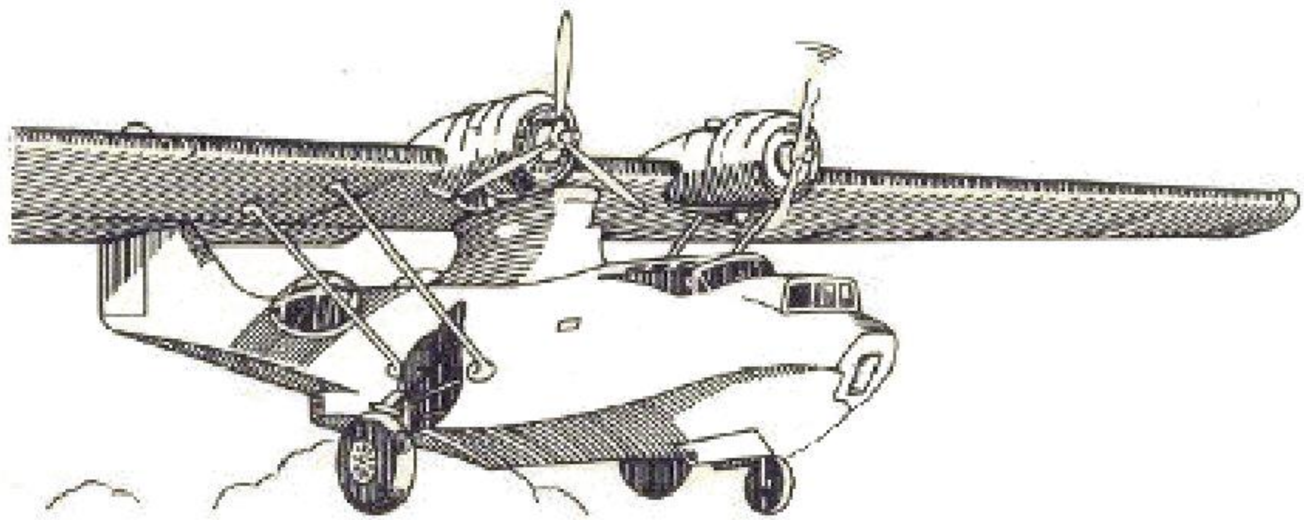
**SNAGS??**

| | |
|---|---|
| **AIRCRAFT SECURE...............................................** | *DOORS / COCKPIT / ENGINES* |
| **LOG BOOK ENTRIES ............................................** | *COMPLETED* |

**CONSOLIDATED**

**PBY-5A**

# EMERGENCIES



## OPERATING PROCEDURES

### 1.30 EMERGENCY OPERATING PROCEDURE Land and Water

*A pilot's ability to cope with an emergency varies in proportion to the amount of training, knowledge and discipline he / she possesses. Pilots are able, through an annual training program, to refresh their memories and to practice simulated emergency procedures. This must be augmented by constant vigilance and study if a safe standard of professionalism is to be maintained. This section of the handbook is intended as a guideline and aide-memoire.*

a. **ENGINE FAILURE ON TAKE-OFF**

**Vmc** of the Canso has been set at 85 knots (military manuals show it as 83 knots}. It should be carefully noted that this is with the good engine at full power and gear and floats fully retracted. `

If doubt exists as to whether the aircraft can maintain speed in excess of Vmc and clear all obstructions then a landing should be made immediately.

If it is decided to continue the take-off after an engine failure the Basic Drill applies as it does to all engine-failure procedures.

However, owing to the proximity of the ground and the possibility that decaying airspeed and loss of ground effect may make themselves felt, no time should be lost in carrying out the ***C-P-D-I*** drill.

***CONTROL***

Must be maintained so that high obstructions can be avoided and a rate-of-climb initiated.

***POWER***

is already at take-off setting on the good engine.

***DRAG***

Must be reduced by feathering the engine that has failed and raising the wheels and / or Floats. IF the starboard engine has failed, the auxiliary hydraulic pump must be switched on. (Some pilots exercise the option of turning the auxiliary hydraulic pump on for all land take—offs).

Remember that the gear will take longer to retract if only the auxiliary pump is used.

The floats take about twenty seconds to retract and lock up.

***IDENTIFY***

The immediate indication is the ***"Dead Foot - Dead Engine"***rule, but this should be confirmed by closing the throttle of the suspected engine. When the failed engine is positively identified, it may be feathered and this should only be done by the pilot. He may elect to feather or he may wait until the throttle is closed. He may also order the co-pilot to push the feather switch. If he does so, he must include in his verbal command the identity of the engine and he must see that the co-pilot is touching the correct button. It is the responsibility of the pilot to see that the correct action is taken. After feathering is complete, the co-pilot will carry out the shut-down drill, using the Check List.

## OPERATING PROCEDURES

b. **Engine Failure: General**

The types of engine failure during flight and conditions of the failure vary considerably, but in all cases it is necessary to apply the power required to maintain flight, identify the malfunctioning engine and then take the necessary action. In the case of an engine failure the following general procedures should be carried out immediately:

**C** - *CONTROL* **- Maintain Heading using Rudder and Rudder Trim**
**Maintain Altitude using Elevator**
**P** - *POWER* **Mixture Rich – Pitch – Full Fine – Throttles – Take-Off power**
**D** - *DRAG* **Gear Up – Floats Up**
**I** – *IDENTIFY* ***Dead Foot Dead Engine***
***V* –** *VERIFY*

c. **Failure Before V1 - Land 84 KTS**

The **MINIMUN CONTROLLABILITY SPEED FOR THIS AIRPLANE** has been determined as **76 Knots**, with one engine inoperative, its propeller wind-milling, floats and gear up, and the opposite engine set for take-off power. Should an engine fail before the airplane has attained a speed of 84 knots, the take-off should be immediately aborted.

**Throttles ………………………….…………..** *Closed*
**Hydraulic Pump ……………………….……...** *On*
**Elevators ……………………….……………** *Full Nose Down*
**Rudder Lock …………………….……………** *On*
**Brakes …………………………………………** *Apply*
**Mixtures ……………………………………….** *ICO as Required*

d. **Failure Before VI - Water 84 KTS**

**Throttles ………………………………………..** *Closed*

**Hydraulic Pump ………………………………** *On*

**Floats …………………………………………..** *Down*

## OPERATING PROCEDURES

e. **Failure after VI - Engine & Fire Check**
Where it is necessary to obtain altitude immediately, landing gear or floats should be retracted. However, the hydraulic pump is located on the starboard engine, so failure of that engine will make retraction of the landing gear impossible except by use of electric hydraulic pump, or hand pump. SEE "EMERGENCY OPERATION OF LANDING GEAR".

| | |
|---|---|
| **MIXTURES** | *RICH* |
| **PTICH** | *FULL FINE* |
| **POWER** | *MAXIMUM* |
| **LOAD** | *JETTISON* |
| **GEAR & FLOATS** | *UP* |
| **HYDRAULIC PUMP** | *ON* |

******** IDENTIFY DEAD ENGINE*******

| | |
|---|---|
| **THROTTLE** | *CLOSED* |
| **PITCH** | *COURSE* |
| **MIXTURE** | *ICO* |
| **FEATHER BUTTON** | *PUSH & RELEASE* |

******** WITH FIRE LIGHT************

| | |
|---|---|
| **FIRE WALL SHUT-OFFS** | *ON COMMAND* |
| **FIRE EXTINGUISHER** | *SELECT/PULL ON COMMAND* |
| **CHECK FOR FIRE** | |

**NOTE:Engine Fire Extinguishers** – There is a non-automatic $CO_2$ pressure system

******* CLEAN-UP CHCEKLIST *******

| | |
|---|---|
| **FEATHERING BUTTON** | *CHKID OUT* |
| **MAG** | *OFF* |
| **GENERATOR** | *OFF* |
| **BOOST PUMP** | *OFF* |
| **FUEL SELECTOR** | *OFF* |
| **COWL FLAPS** | *CLOSED* |
| **HYDRAULIC PUMP** | *AS REQ'D* |
| **SET POWER ON GOOD ENGINE** | *AS REQ'D* |

## OPERATING PROCEDURES

**Failure after VI - Engine & Fire Check** (continued)

Floats are controlled electrically so failure of an engine will not affect their operation. Time required to retract floats is twenty seconds (20 sec).

The airplane must be trimmed (rudder tab first, aileron tab second) for as good a "Hands Off" condition as possible.

### 1.31 Propeller Over-speed

This situation usually results from a malfunction in the propeller dome rather than in the governor. It can manifest itself as an over speed mode caused by an unexpected and continuous increase in RPM and the blades going into "flat" pitch or it may range through several pitch changes in a short period of time which cannot be controlled by using RPM controls or reducing Manifold Pressure.. If the pitch control lever movement has no effect on the propeller and if the feathering system fails to function, the propeller is uncontrollable and if not brought down to a safe speed, may cause disintegration of the engine. Immediate action is to stop the engine by Idle Cut Off and at the same time reduce the airspeed to as low a value as possible commensurate with safety.
Land as soon as possible

**THROTTLE.............................................................** *REDUCED*

**PROPELLER..........................................................** *COARSE*

**If able to control propeller slow to 90 knots and use minimum power on failed prop not to exceed 2700 RPM. Land at first suitable site.**

**IF UNABLE TO CONTROL PROPELLER**

**THROTTLE ............................................................** *CLOSED*

**MIXTURE ...............................................................** *ICO*

**PROPELLER .........................................................** *FEATHERED*

### 1.32 Feathering Pump Run-On

**FEATHERING BUTTON ........................................** *CHECKED OUT*

**CIRCUIT BREAKER ..............................................** *PULL*

**BATTERY ..............................................................** *DISCONNECT*

## OPERATING PROCEDURES

### 1.33 Electrical Failure

a. **General** If power is lost slowly and gradually, a generator failure is indicated. In this case, all power should be shut off to allow the battery to regain a small amount of power chemically. An instantaneous loss of power is usually a battery problem and the first thing to check is the battery connection. In the Canso, due to the practice of disconnecting the battery manually at frequent intervals, the connector is sometimes easily displaced. In all cases of electric failure the possibility of fire should be considered and an investigation carried out.

b. **Electrical Fire**

**MASTER ..................................................................** *OFF*

**GENERATORS......................................................** *OFF*

**EXTINGUISH & SMOKE EVAC.............................** *AS NECESSARY*

**ALL ELECTRICAL ……………...............................** *OFF*

**CIRCUIT BREAKERS ............................................** *CHECK*

**NECESSARY ELECTRICS ....................................** *IN*

### 1.34 Unfeathering Procedure

**Fuel Selector Valve ................................................** Selected

**Mixture......................................................................** ICO

**Propeller...................................................................** High RPM

**Throttle......................................................................** Cracked

**Firewall Shut-Off.....................................................** Open

**Magneto's ...............................................................** On

**Feather .....................................................................** Push - 800 RPM

**(At 800 RPM release button but do not bring mixture up until RPM is 12-1300 )**

**Mixture .....................................................................** Auto Rich

**( Warm up at not more than 1400 RPM until CHT (120°C) is reached )**

**Temps & Pressures ................................................** Checked.

**Cowl Flaps …..........................................................** Adjusted

**Generator.................................................................** On

**( adjust to cruise power)**

## OPERATING PROCEDURES

1.35 **Fire**

**In Engine Area** - Carry out drill for in-flight engine shutdown. Ensure that engine is stopped, fuel shut-off closed, firewall valves closed and cowl gills closed before using extinguisher.

**In Cabin Area** - Use portable fire extinguisher and guard against inhaling smoke fumes. Do not ventilate cabin for smoke evacuation until fire is OUT.

**Brake Fire** - Leave brakes off, approach with caution as tire and wheel may explode. Use powder type extinguisher or sand. DO NOT USE CO2 extinguisher or liquid. Guard against re-ignition.

1.36 **Hydraulic Failure**

If power is lost slowly and gradually, a generator failure is indicated. In this case, all power should be shut off to allow the battery to regain a small amount cf power chemically. An instantaneous loss of power is usually a battery problem and the first thing to check is the battery connection. In the Canso, due to the practice of disconnecting the battery manually at frequent intervals, the connector is sometimes easily displaced. In all cases of electric failure the possibility of fire should be considered and an investigation carried out. (The carrying of Flashlights by Canso pilots is mandatory}.

1.37 **Emergency Lowering of Undercarriage -** In the event of failure of the hydraulic system the following procedure should be carried out to lower the undercarriage:

a. **Main Gear** (See Figure 18)

(1) Set undercarriage selector in "DOWN" position

(2) Open hatch on inside wall of wheel well and pull "UP-LOCK EMERGENCY RELEASE" toggle located on wheel well wall beside hatch, and at the same time push wheel strut outboard while aircraft is rocked in the rolling plane. Wheel gear will then, fall outboard.

(3) When gear is outboard remove "Down Latch Rod" from stowage in compartment C/D and engage hinged section of bar in socket of main wheel strut, resting end of main rod in fulcrum socket inboard of hatch. Lever down latch rod to push strut outboard until latch engaged in "Down" position. Check latch after removing latch rod.

(4) Repeat for opposite wheel.

## OPERATING PROCEDURES

b. **Nose Gear** (See Figure 20)

(1) Reduce Airspeed to 90 knots.

(2) Set undercarriage selector in "DOWN" position and carry out the following EMERGENCY NOSE GEAR LOWERING procedure:

(a) Unlock nose wheel doors by lifting the floorboard door located in compartment “A” reach down and pull the door lock handle aft (towards you) thus releasing the nose door pins.

(b) Move back to Compartment “C” and insert Hydraulic Hand Pump Handle or Emergency “DOWN LATCH” lever handle in the aft end of the starboard door torque tube (aft of bulk head 2 behind cockpit) and push inboard (counter clockwise), rotating the torque tube and thus opening the nose wheel well doors.

(c) Lock torque tube in “DOOR OPEN” position by swinging locking link inboard over the lug on the torque tube end fitting. Insert lock pin and retain with safety pin.

(d) Remove aft (RED) nose wheel cover plug (located in the floor between the instrument panel and control yoke) and insert emergency lever through the hole. Strike the end of the “UP-LATCH” sharply to unlatch the nose gear.

(e) Attach the Emergency lever ratchet end to the torque tube between the packing and the jack fitting (located fore of the co-pilots rudder pedals) so that the ratchet pawl fits into the teeth of the jack fitting. Using the lever as a ratchet, force the gear into the down position. To lock, use a slow deliberate heavy push until you hear a “VERY LOUD SNAP SOUND”. Do not be afraid to brace your back and use your feet and legs to push the Emergency Lever Ratchet to lock the nose gear down.

(f) Remove the forward (RED) plug (located in the floor behind the instrument panel aft of bulk head #1) of the wheel well cover to examine the down-latch and use the Emergency “DOWN LATCH” lever to determine if the down-latch is locked. If it is locked, the “WHITE COLLAR” on the leaver will not be extended above the hole in the cover, and the oleo strut will be vertical and against the bumper.

**CAUTION** ***Before operating gear again, be sure to release the Emergency Door Lock Pin.***

**PBY C-FUAW**

**MAIN GEAR**

**MANUAL EXTENTION**

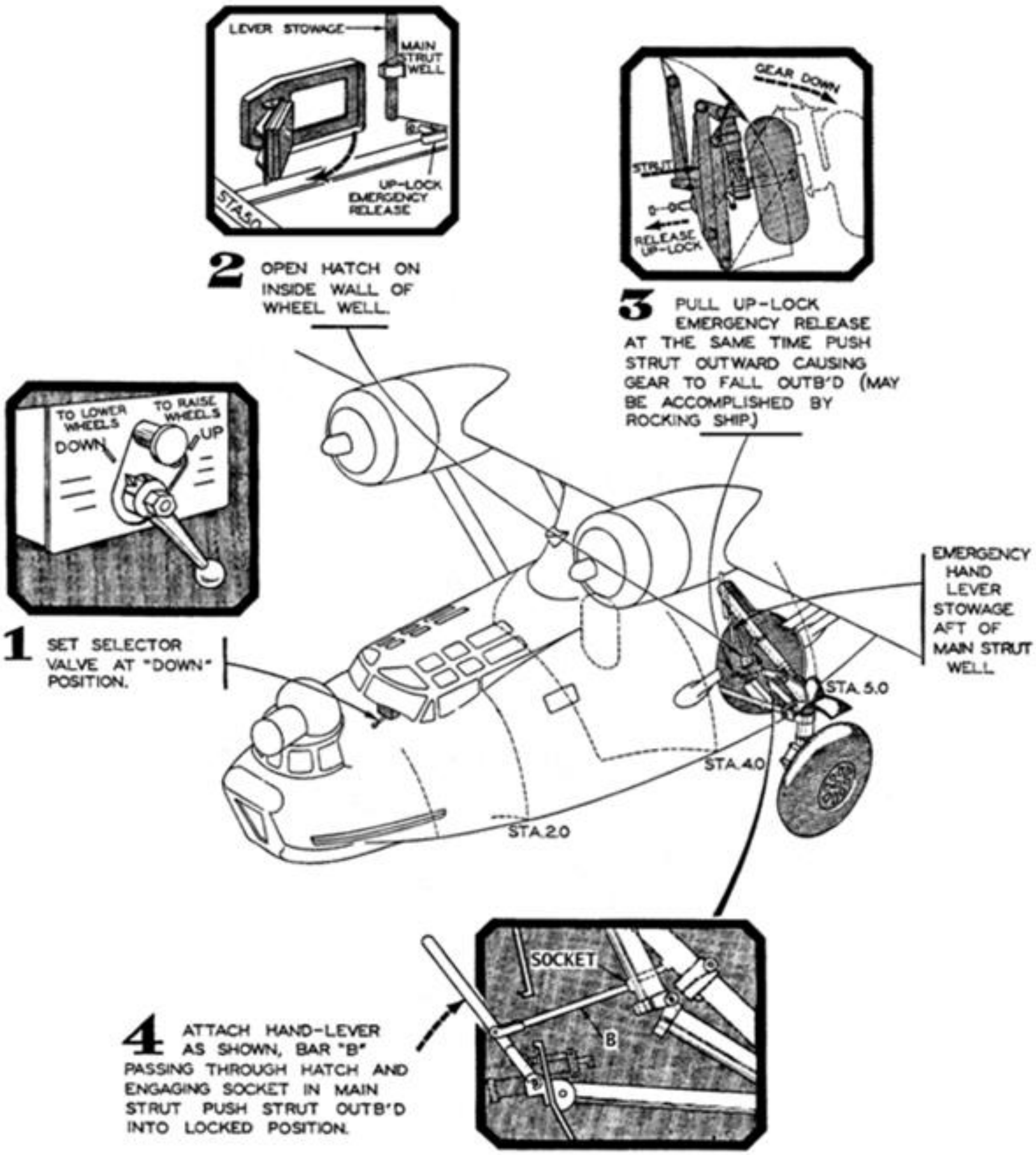
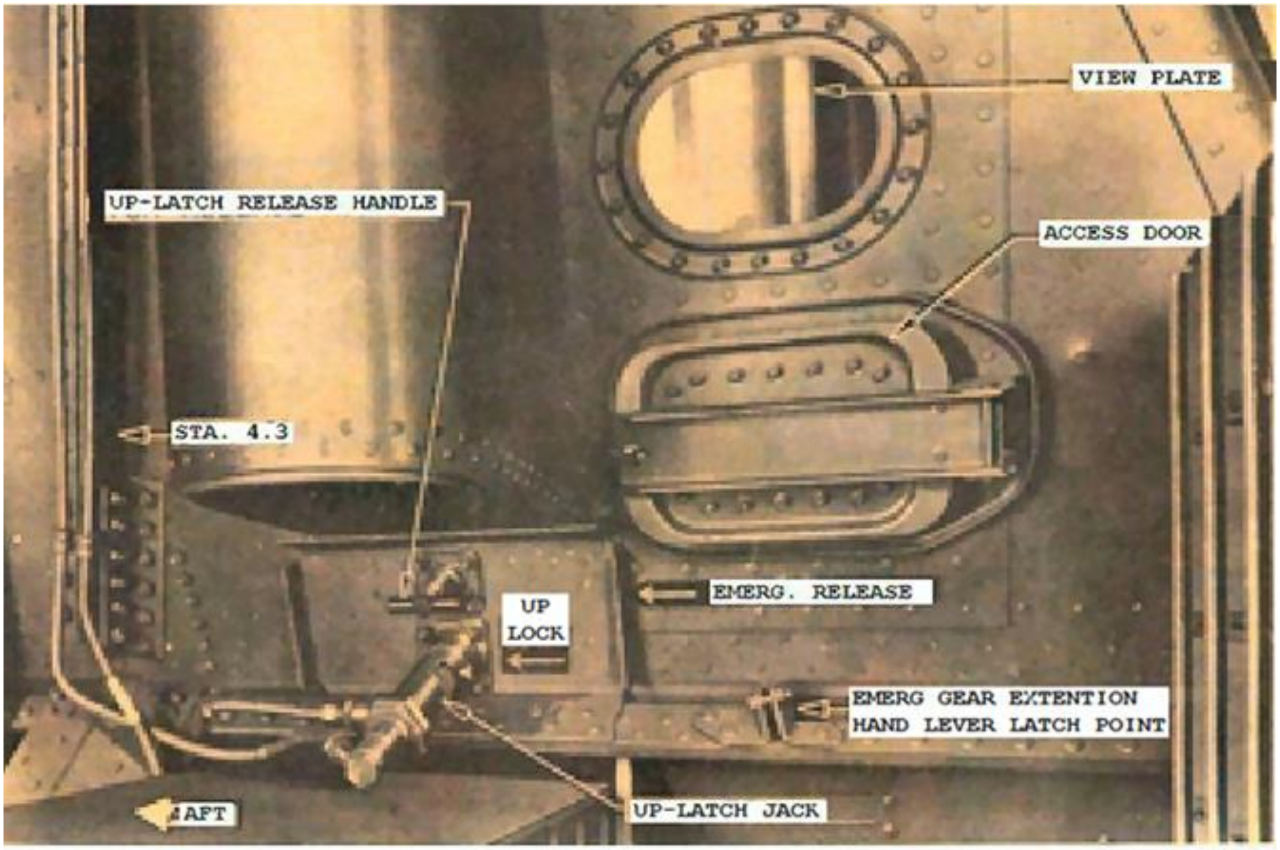



Fig 18

## MAIN GEAR EMERGENCY LOWERING



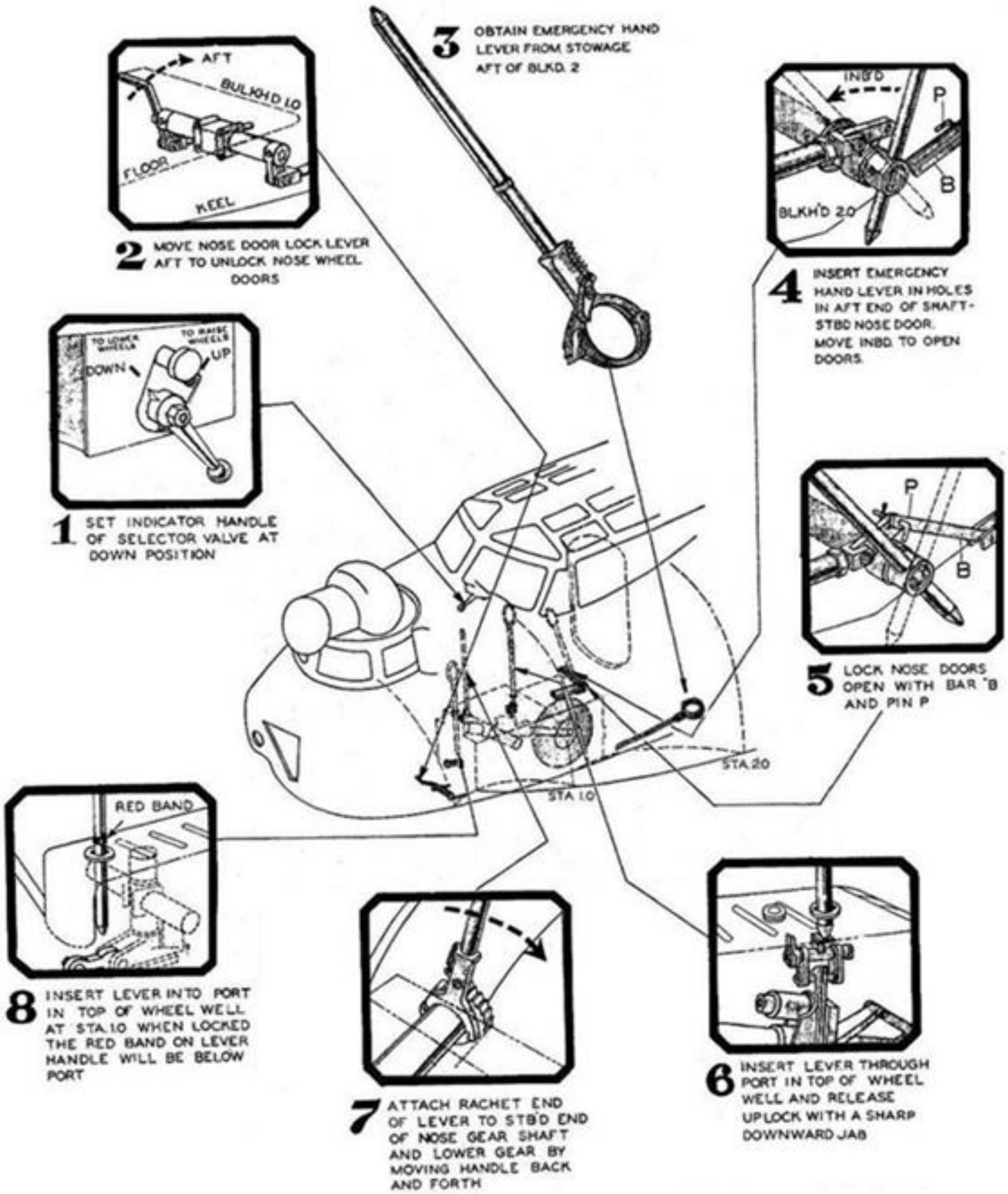

*Emergency Up-Latch Release Handle*

Fig 19

**PBY C-FUAW**

**NOSE GEAR**

**MANUAL EXTENSION**

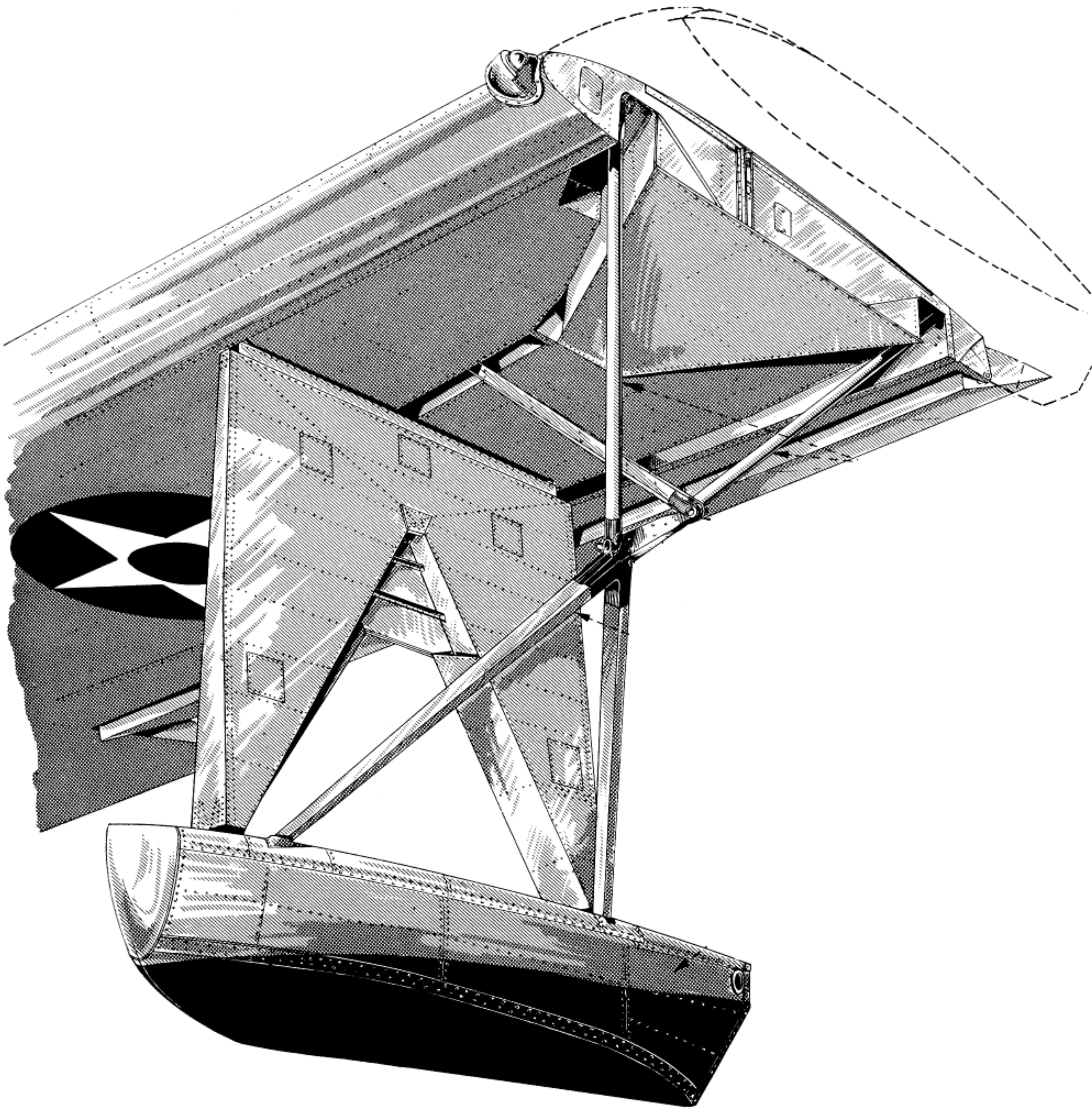



Nose Gear Emergency Lowering

Fig 20

# OPERATING PROCEDURES

## WING TIP FLOATS



## OPERATING PROCEDURES

## FLOATS OPERATION

### 1.38 GENERAL

Retractable wing floats are provided to give the aircraft lateral stability when on the water. In the retracted position, the floats form the wing tips, and the drag panel (the main float supporting structural member) is retracted completely in the wing to form a continuous lower wing surface to reduce drag and increase the over-all efficiency of the aircraft. The wing floats system can be divided into three major components: The floats proper,

a. The drag panel and "VEE" struts,
b. The retracting mechanism

### 1.39 DESCRIPTION

Each float structure is of a stressed skin, all metal aluminum alloy construction, consisting of six transverse frames and bulkheads, and longitudinal stringers. Each float contains three water tight compartments, which are vented by tubing into the drag panel. The vent lines should be kept unobstructed at all times to prevent possible rupturing of the float skin due to differences of pressure within the float and the atmospheric air at high altitude.

To give access to the interior of the float for periodic inspection or repair, five doors are provided on the upper surface of the float. These doors are a structural part of the float and must be securely fastened to the deck with screws to prevent possible buckling of the float skin and leakage of water into the water tight compartment of the float.

### 1.40 Normal Float Operation

#### a. Floats Retracting Mechanism

Retraction and extension of the floats is powered by an electric motor or hand crank working through the gear box on the forward face of bulkhead No. 4. This gear box couples the motor or hand crank to the float retracting mechanism through a series of gears which provide the necessary gear reduction to the vertical torque tube. There are two speeds for emergency float operation, a slow speed for heavy loads on the retracting system, and a fast speed when light loads are imposed on the retracting system. A locking mechanism consists of a spring loaded pawl at the outer end of each wing is provided to hold the floats in retracted position. The hand crank for emergency float operation is located in the pylon.

No mechanical lock is provided for the floats in the "DOWN" position as the folding "VEE" struts attain locked position just past dead center.

**CAUTION** Float warning light will be on until floats are locked down.

## OPERATING PROCEDURES

## FLOATS OPERATION

### 1.41 To Lower the Floats

a. Turn float switch on pilot's electrical panel to "FLOATS DOWN" position

b. If throttles are retarded to 15 inches Hg manifold pressure, the float warning lights on the pilot's instrument panel will go on until floats are down and latched. The wheel indicator lights will show "MAIN LANDING GEAR UP' and "NOSE WHEEL DOOR LOCKED".

**CAUTION** Do not begin to lower floats at speeds greater than 140 mph / 121 knots

### 1.42 To Raise the Floats

a. Turn float switch to "FLOATS UP"

### 1.43 Emergency Operation of the Floats

In the event of the failure of the electric float gear, the following procedure should be used:

a. **To Lower Floats**
Remove hand crank from the stowage in pylon
Check Float switch "OFF" and "PULL" circuit breaker
Engage crank in socket marked "FAST"
Crank counter clockwise until floats are fully lowered

b. **To Raise Floats**
Check float switch "OFF" and "PULL" circuit breaker
Insert crank in socket marked "FAST" and crank clockwise until load becomes too heavy to handle

When load becomes heavy, transfer crank to socket marked "SLOW" and continue cranking in a clockwise direction until floats are latched in UP position

**CAUTION** *Before initiating manual Emergency Float Operations, place the electrical float operating switches in the "OFF" position*

**FLOAT OPERATION**

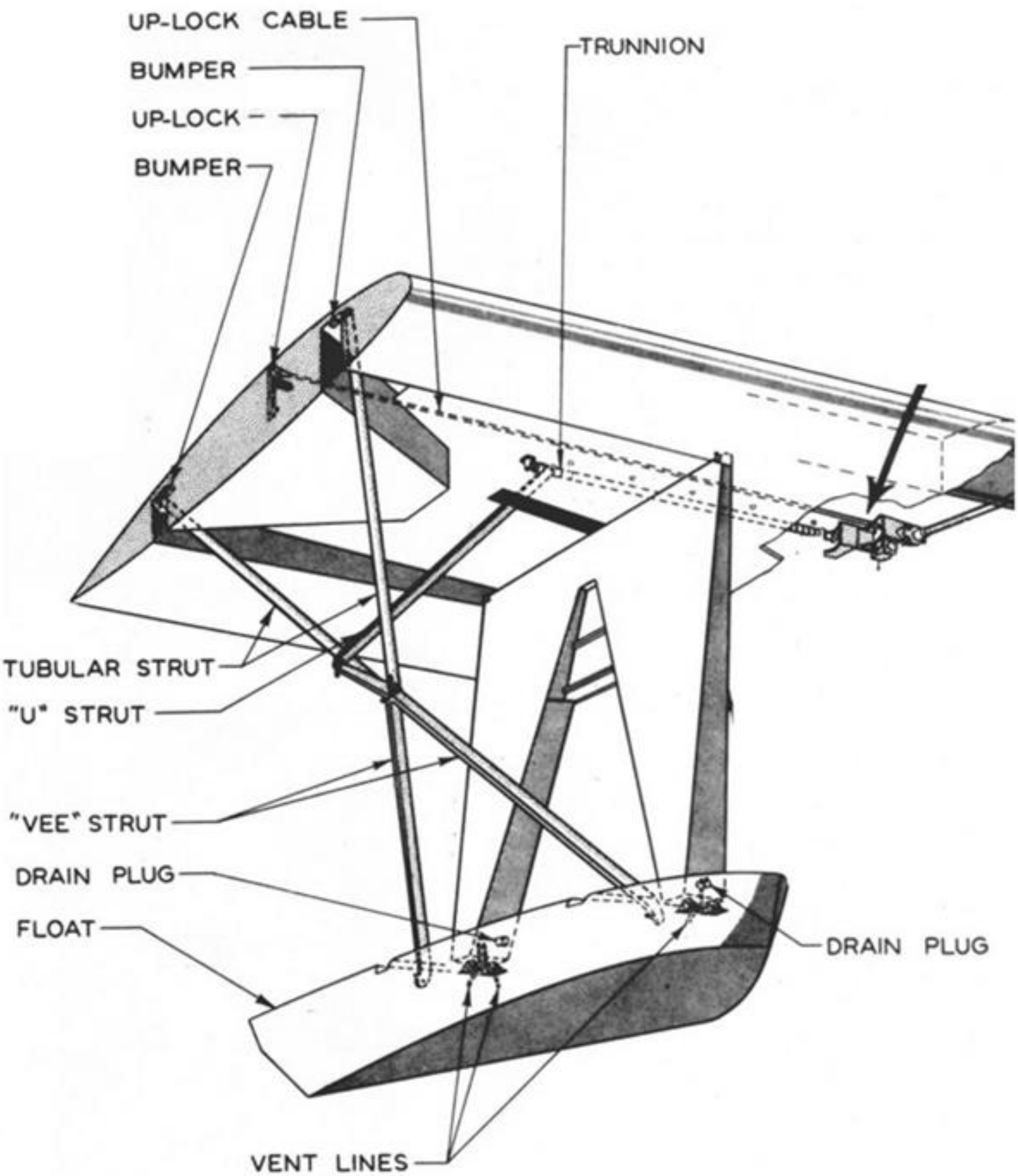
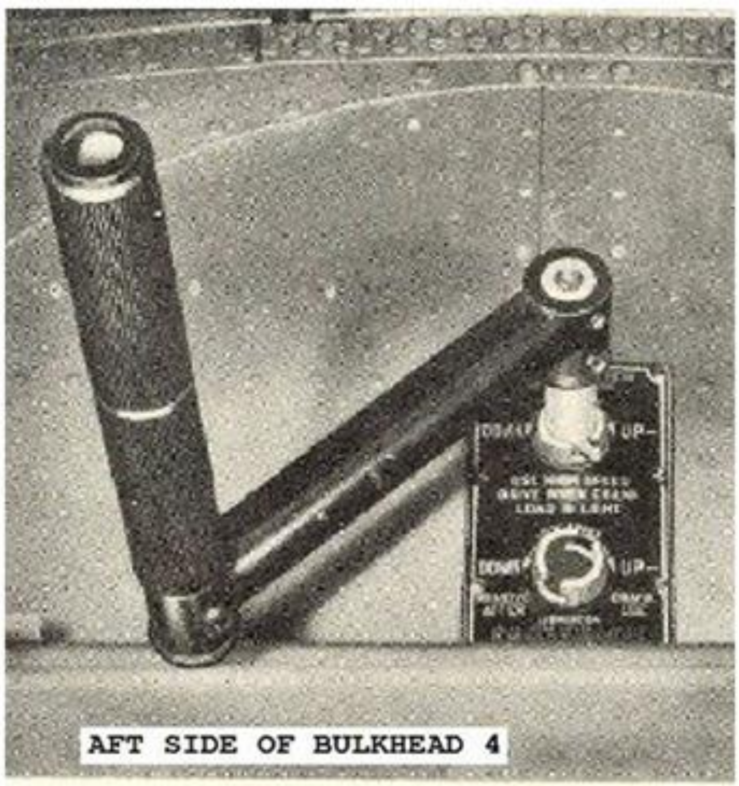



Fig 21

## FLOAT OPERATION


Fig 22




*Float Crank Ready to Operate*

*READ THE FLOAT RAISING AND LOWERING PLAQUE BEFORE OPERATING CRANK*

Fig 23

**Float Retraction Mechanism** 1.10.7

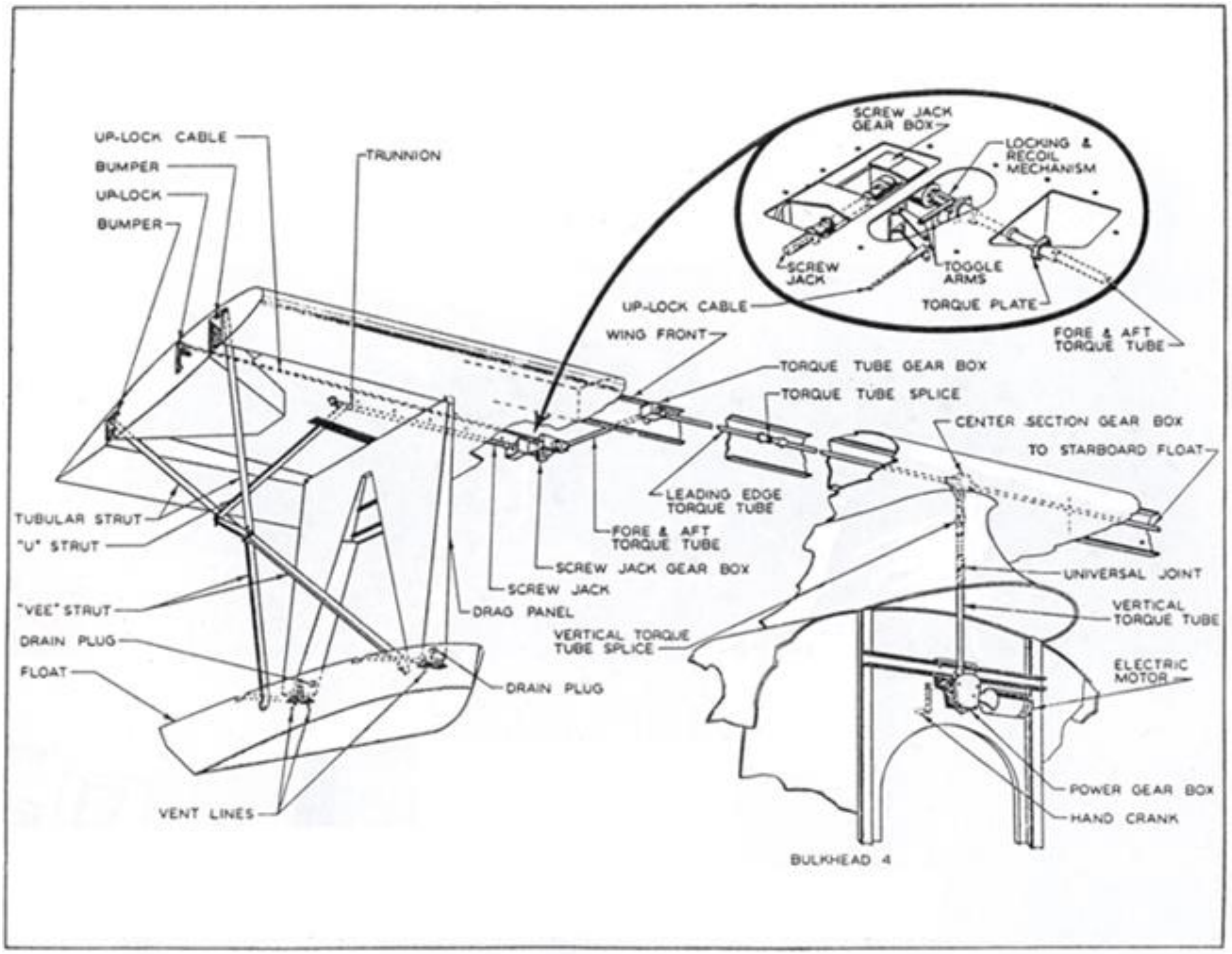



Fig 24

## HYDRAULIC SYSTEM

## HYDRAULIC SYSTEM

### 1.44 General Description of Units

**The main units of the hydraulic system are:**

a. Engine Driven Pump
b. Hand Pump
c. Electric Auxiliary Pump
d. Reservoir
e. Unloading Valve
f. Accumulators
g. Relief Valve
h. Return Valves
i. Selector Valve
j. Check Valves
k. Actuating Cylinders
l. Latch Releasing Cylinders
m. Sequence Valves
n. Power Brake Valve
o. Brake Deboosters
p. Filter
q. Pressure Gauge

### 1.45 Engine Driven Pump

Is a gear, two gpm Pasco type, and is mounted on the starboard engine. The intake is connected to the reservoir by a cotton reinforced 5/8" flexible tube. The pressure outlet is connected to the pressure line by means of a metal braid reinforced 1/2" flexible tube.

### 1.46 The Hand Pump

Is located inboard of the co-pilot's seat where it is accessible to either pilot. The suction line of the pump which connects to the aft end of the pump connects directly with the reservoir. The line that connects to the top of the pump is the pressure line and it connects to the main system just forward of the unloading valve. The hand pump is primarily used to operate the landing gear up or down in cases of emergency or functional necessity.

### 1.47 Electric Auxiliary Pump

An electric hydraulic auxiliary pump is fitted on all aircraft which supplies emergency hydraulic pressure in the same manner as the hand pump.

## HYDRAULIC SYSTEM

### 1.48 The Reservoir

Is mounted on the right hand side of the starboard nacelle just aft of the firewall, and has a capacity of 2 Imperial gallons. There are three lines connected to the reservoir. One is the return line from the main hydraulic system which connects to the reservoir about 6 inches from the bottom and at an angle which prevents vortexing of fluid. The second line connects to a fitting that leads to the engine driven pump and is the pump's suction line. The third line is a suction line for the hand pump. The cap on top of the reservoir is vented and should be kept free of obstructions. In filling the reservoir, instructions on the name-plate should be followed.

### 1.49 The Vickers Unloading Valve

The Unloading Valve maintains a constant pressure in the hydraulic system of 850 to 1050 PSI. It operates in conjunction with the accumulators which are necessary for correct operation of this valve. Its primary function is to supply the main hydraulic system with pressure to operate the landing gear. It also relieves the main engine pump of constant pumping under load, thereby decreasing wear on the engine pump. There are four lines connected to this valve. The line connected to the right hand port of this valve is the pressure line coming directly from the engine pump. The small line on top of the valve is a chamber bleed line that also connects to the return. The lines that connect to the forward end of the valve are all pressure lines; one comes from the hand pump; another connects to the small 5" accumulator; another connects to the 10" accumulator. This valve is located on the hydraulic platform.

### 1.50 The Accumulators

10" and 5" accumulators are used in the hydraulic system for the following reasons. First, the Vickers unloading valve will not function without them. Second, storage of pressure must be maintained for emergency operation of brakes and to supply pressure to brakes while airplane is parked. The 10" accumulator is used only in the brake system. Third, the accumulator will give partial operation of the system and act as a shock absorber. The accumulator is built in two sections separated by a diaphragm. Nitrogen pressure of 600 PSI is maintained in the lower half of the accumulator when all fluid has been removed from the upper half of the accumulator.

### 1.51 The Selector Valve

Mounted below the instrument panel and to the left of the centre line of the aircraft, it controls the operation of the landing gear to an up or down position. An adjustable thermal relief mechanism is also incorporated in this valve.

# HYDRAULIC SYSTEM

## 1.52 Actuating Cylinders

Are coupled direct to the respective mechanisms they operate, namely, main landing gear cylinders, nose wheel cylinder, and nose door cylinder. The pressure in the hydraulic system acts upon the pistons inside these cylinders forcing them in or out, which actuates the main landing gear, doors, etc.

## 1.53 Latch Releasing Cylinders

Sometimes referred to as unlatching jacks, are located at all main gear locks. There are six of these jacks used. Four are located in the main wheel wells. Another is located at the up-lock of the nose wheel, and another located at the down-lock of the nose wheel. These unlatching jacks perform two functions. The first function is to unlock the lock (up or down). The second function, as can be seen by the flow diagram, is to act as a sequence valve and transmit fluid under pressure to the next sequence of operation, which is the operation of the actuating cylinders.

## 1.54 The Sequence Valves

There are three types of sequence valves; mechanical, snap action, and combination door lock and sequence valve.

a. **The Mechanical Sequence Valves** - of which there are two are located just above the keel on the aft face of bulkhead No.2. These valves are operated mechanically in conjunction with the nose doors. The bell-crank on the starboard door torque arm contacts one valve when the doors are in the open position and contacts the other valve when the doors are in the closed position. The sequence valve farthest outboard connects to the up line of door cylinder and should not operate until doors are fully closed. Its sole function is to lock the nose doors after they are completely closed. The other sequence valve, which is the one mounted vertically, is operated only when the nose doors are in the open position, and is connected to the down line of the nose door cylinder and to the nose wheel up-lock or unlatching jack. Its purpose is to provide pressure for lowering the nose gear after the nose doors are completely open.

b. **The Snap Action Sequence Valve -**is located on the starboard side of the auxiliary keel just below the co-pilot's left control panel. Its operation in relation to the hydraulic system is to function at a desired interval and at the exact time the nose gear is up and locked. This valve is operated when it is engaged with the bell-crank attached to the torque arm of the nose gear. The forward port on this valve connects with the nose door cylinder up line. The aft port connects with the up line of the selector valve. Its operation provides pressure to the nose door cylinder.

c. **The Door Lock and Sequence Valve -** is located in the bilge just forward of the bulkhead No. 1. This valve is a combination actuating cylinder and sequence valve. The starboard side of the valve is the actuating cylinder side and is connected to the door locking pins. The port side attached to the opposite side of the valve. The actuating side of the valve is evident. It merely locks or unlocks the nose doors. The sequence side of the valve controls the timing of operation of the nose door to the open position, and operates only at the time when the door locking pins have unlocked the nose doors. All sequence valves in this hydraulic system are adjustable.

## HYDRAULIC SYSTEM

d. **The Power Brake Valve -** Is a right and left brake built into one integral unit and is located between bulkheads No. 1 and No. 2 starboard of the co-pilot's right control pedal. It is operated by either pilot or co-pilot and is connected to the dual brake pedals by means of a parallel linkage and cable system. Pressure to operate the valve is supplied by the 10" accumulator and connects with the pressure inlet port, which is the port farthest starboard. The return line of the brake valve is located in the center and on top of the valve. The brake pressure, 3/8" lines are located at the forward and aft ports of the valve.

The brake valve is adjustable and is set for a maximum pressure of 600 ± 50 PSI. To operate parking brakes, a locking pawl is held clear of the arm and linkage by means of a spring attached to the hull bottom. By turning the parking brake knob, located just below and to the right of the co-pilot's instrument panel, this pawl may be pulled down so that it engages and locks the arm and linkage in the "BRAKES ON" position. It is necessary to have the brake "ON" before the pawl engages the arm. When it is desired to release the brakes, pressure on the brake pedals will move the arm and linkage enough to disengage the locking pawl which will be pulled into its inoperative position by the spring.

1.55 **The Brake Deboosters -** Sometimes called Power Brake Master Cylinders, are located just forward of bulkhead No. 4 on the hull bottom. There are two deboosters; one for each wheel brake. The outboard port of these deboosters, (high pressure side) connects directly with the brake valve. The starboard and port sides connect directly with the wheel brake. These deboosters essentially consist of a steel cylinder barrel fitted with a spring loaded piston that divides the cylinder into two pressure chambers -a high pressure, small volume chamber and a low pressure, large volume chamber. The latter chamber is approximately three times the area of the high pressure chamber, which gives a usable operating pressure for the wheel brakes (125 PSI). The low pressure side acts as a deboosting agent inasmuch as it removes the amount of oil used to operate the brakes back into the low pressure chamber of the debooster. A compensating check valve located in the lower end of the high pressure side automatically supplies fluid dissipated by leakage anywhere in the wheel brake system and also provides for bleeding of brakes. The feel of the brakes depends/ largely on the smooth operation of the deboosters.

Note**:** In the event of a hydraulic failure you should have a maximum of 6 applications of brakes in the accumulator.

## HYDRAULIC SYSTEM

1.56 **The Filter -** Is located on the hydraulic platform and is used to filter all foreign material out of the hydraulic system. This filter is of plate type construction and is cleaned by draining the sump at the bottom of the filter at very 60-hour check. A moveable handle is located at the top of the filter and should be turned one complete revolution before each flight (done on Daily Inspection)

1.57 **The Pressure Gauge-** Is located on the instrument panel and used to indicate the system pressure at all times. This gauge should read between 800 and 1100 PSI when hydraulic system is being operated. This gauge does not indicate pressure in the brake system or 10" accumulator. It is connected to the pressure line entering the selector valve.

Note**:** It takes approximately 7 gallons of hydraulic oil to completely fill the hydraulic system. The hydraulic system reservoir holds 2 gallons.

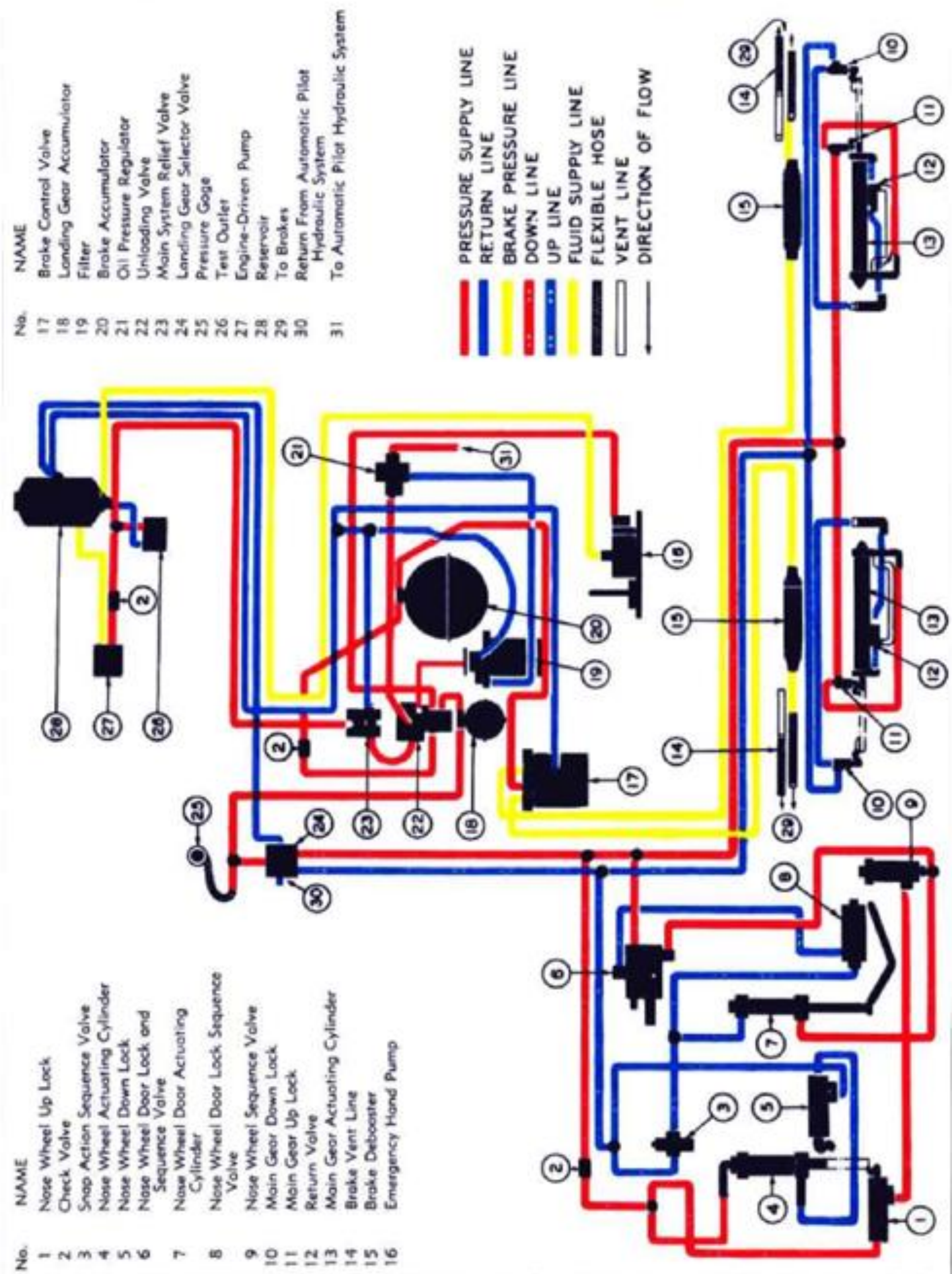

No. NAME
1 Nose Wheel Up Lock
2 Check Valve
3 Snap Action Sequence Valve
4 Nose Wheel Actuating Cylinder
5 Nose Wheel Down Lock
6 Nose Wheel Door Lock and Sequence Valve
7 Nose Wheel Door Actuating Cylinder
8 Nose Wheel Door Lock Sequence Valve
9 Nose Wheel Sequence Valve
10 Main Gear Down Lock
11 Main Gear Up Lock
12 Return Valve
13 Main Gear Actuating Cylinder
14 Brake Vent Line
15 Brake Debooster
16 Emergency Hand Pump
No. NAME
17 Brake Control Valve
18 Landing Gear Accumulator
19 Filter
20 Brake Accumulator
21 Oil Pressure Regulator
22 Unloading Valve
23 Main System Relief Valve
24 Landing Gear Selector Valve
25 Pressure Gage
26 Test Outlet
27 Engine-Driven Pump
28 Reservoir
29 To Brakes
30 Return From Automatic Pilot Hydraulic System
31 To Automatic Pilot Hydraulic System
PRESSURE SUPPLY LINE
RETURN LINE
BRAKE PRESSURE LINE
DOWN LINE
UP LINE
FLUID SUPPLY LINE
FLEXIBLE HOSE
VENT LINE
DIRECTION OF FLOW

Fig 25

## VACUUM SYSTEM

# VACUUM SYSTEM

## 1.58 Gyroscopic Instruments

The gyroscopic instruments are operated by two (2) vacuum pumps, one mounted in the rear of each engine. The vacuum lines come to a selector valve on the pilot's instrument panel and are each provided with a suction regulating valve mounted in the rear of the pilot's panel.

The gyroscopic instruments are divided into two groups, each group driven by one (1) vacuum pump.

One group includes the gyro horizon, the pilot's Directional gyro and the Turn and Bank indictor.

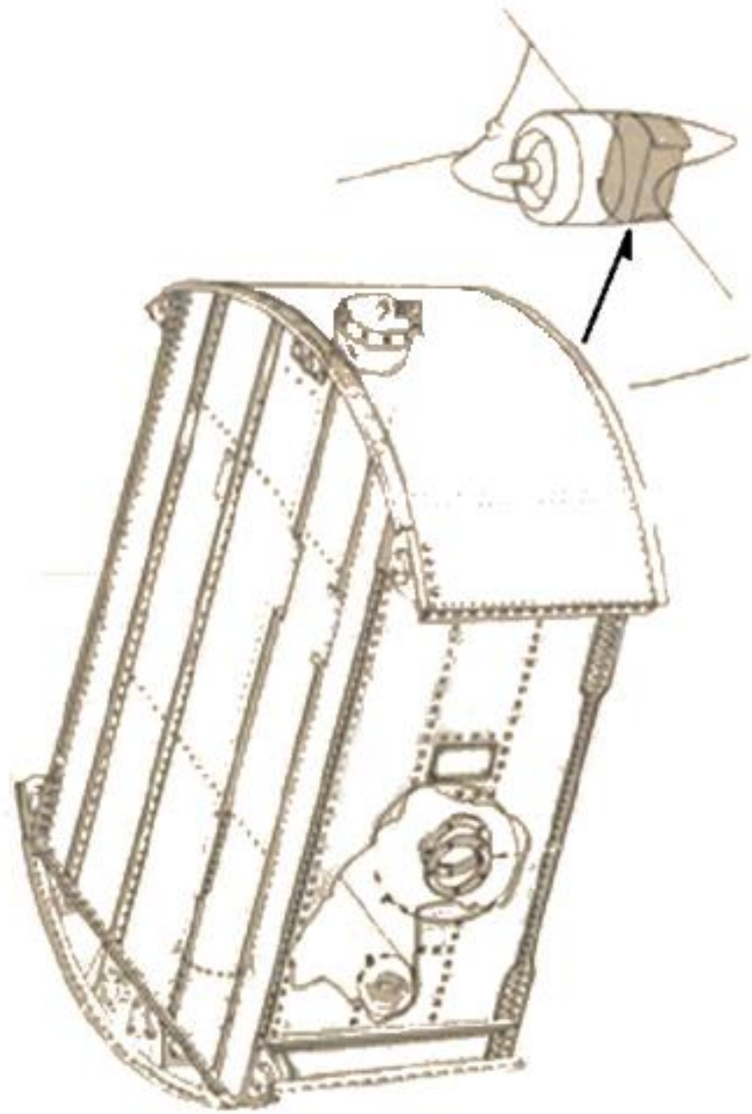
The other group includes the co-pilot's Directional gyro, Turn and Bank indicator and Gyro Horizon.

Either Group can be operated from either vacuum pump by means of the selector valve, thus insuring operation of desired instruments in the event of the failure of one pump.

The Directional Gyro and the Artificial Horizon connections are made through short lengths of flexible tube. The instrument panel is shock-mounted. The gyro Horizon and the Directional gyro should be operated on a vacuum supply of 3.5 to 4 inches of Mercury.

Selector Valve has been removed on some aircraft and some Turn and Bank instruments are now electric.

## OIL SYSTEM



PBY-5A Oil Tank and placement

# OIL SYSTEM

## 1.59 General

Each engine has a separate and completely independent oil system. The oil system supply for each engine is carried in a tank in the nacelle. This tank forms a part of the nacelle structure, and the power plant mounts to its forward face. The oil flow through the oil temperature regulator is automatically controlled by a thermostatic element in the regulator. Air flows through the cooler at all times and is not controlled.

Oil returning from the engine enters the oil temperature regulator located under the engine mount, and flows from the regulator through a "cold" oil return line to a hopper-type warming compartment in the tank, or through a "hot" oil return line to the oil cooler and then through the oil cooler to the top of the tank.

A line connected to a box on the bottom of the oil tank outlet casting furnishes the propeller fast feathering pump with a supply of oil.

An important factor in preventive maintenance is the careful monitoring of the rate of consumption of engine oil. Accommodation is made for this requirement by the Flight Release Certification (Form AA-2). Air-crew must ensure that all additions of oil to tanks while away from base (e.g. during a ferry flight without crewman on board) are carefully and properly noted, along with an in-flight record of temperatures and pressures.

## 1.60 System Capacity

The total capacity of each oil tank is 63.2 Imperial gallons, but the tanks should not be filled above 54.1 Imperial gallons since a foaming space of 9 gallons is required.

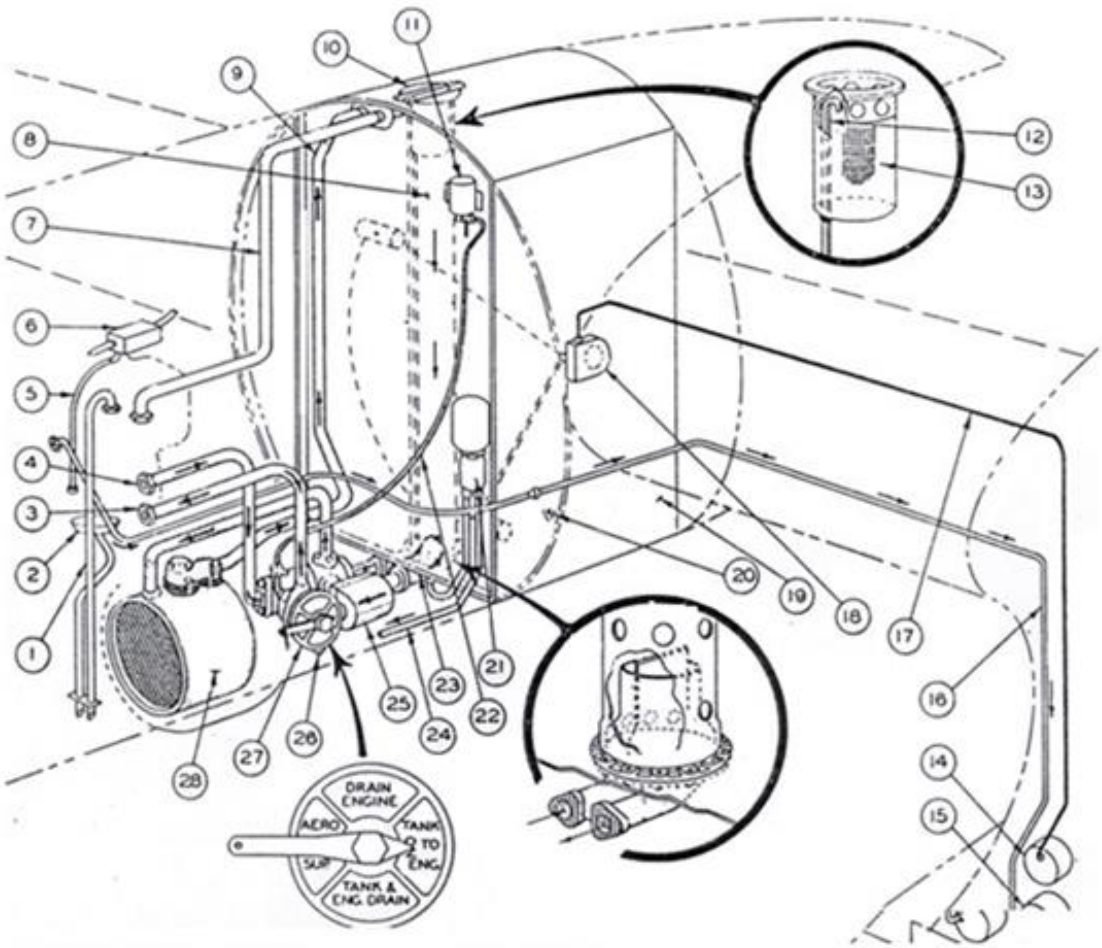
Under normal conditions from 25 to 30 gallons is sufficient to achieve maximum available cooling and consumption requirements.

## 1.61 Grade

The grade of oil used is:

On a newly overhauled engine mineral oil for the first 100 hours of operation, thereafter 100 Ash Dispersant or 120 Ash Dispersant in higher ambient temperatures.

## OIL SYSTEM




1 CRANKCASE BREATHER LINE
2 DRAIN BELOW OIL SCREEN CHAMBER
3 ENGINE OIL "INLET" CONNECTION
4 ENGINE OIL "OUTLET" CONNECTION
5 RETURN LINE FROM OIL SEPARATOR
6 OIL SEPARATOR
7 VENT LINE FROM OIL SEPARATOR
8 HOPPER
9 RETURN LINE TO TANK
10 FILLER COVER
11 DILUTION SOLENOID
12 SOUNDING ROD
13 STRAINER
14 OIL QUANTITY INDICATOR
15 OIL PRESSURE INDICATOR
16 PRESSURE INDICATOR LINE
17 LIQUIDEOMETER ELECTRICAL WIRING
18 LIQUIDOMETER
19 OIL TANK
20 DRAIN PLUG
21 PROPELLER FAST FEATHERING PUMP
22 OIL DILUTION FUEL LINE
23 SUMP
24 PRESSURE LINE TO PROPELLER GOVENOR
25 AUTOMATIC OIL TEMPERATURE CONTROL
26 DRAIN PLUG
27 DRAIN & SHUT-OFF VALVE
28 OIL COOLER

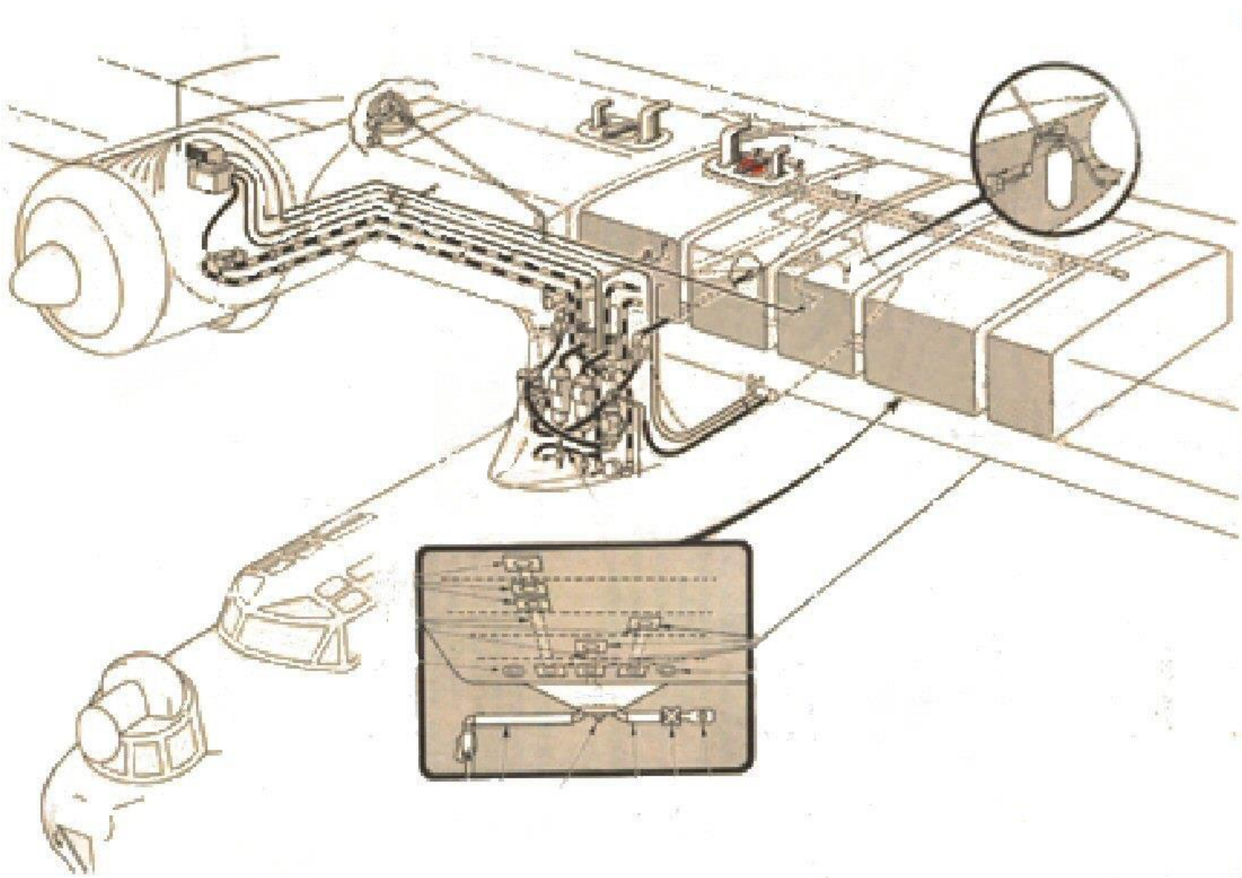
REFER TO C.A.C DWG. 28-0-5000

NOTES

1 CAPACITY TOTAL - 76 U.S. GALLONS ( 63.2 IMP. GALS )
USEABLE- 65 U.S. GALLONS ( 54.1 IMP. GALS )
FOAMING SPACE - 11 U.S. GALLONS ( 9.2 IMP GALS )
2 ALL OIL LINES ARE MARKED WITH 1/2 INCH YELLOW BANDS
3 REFER TO FIGURE FOR DETAILS OF OIL QUNTITY GAUGE TANK UNIT

Fig 26

# FUEL SYSTEM



## FUEL SYSTEM

### 1.62 GENERAL

The Canso fuel system consists of two integral tanks, one in each side of the wing centre section located between the front and rear spars. Together with the fuel sumps located in the pylon the full capacity totals 1457.6 Imperial gallons, each tank and sump holds 728.8 gallons. The capacity of the sump is approximately 5 gallons and it will not be drained by the drain valve for fuel tankering and must therefore be completely drained and flushed at the completion of a fuel tankering operation before being used again to supply aviation fuel for aircraft operations.

### 1.63 SYSTEM UNITS

a. **Engine Driven Fuel Pumps**

When the engines are running, fuel pressure is supplied by the two engine driven fuel pumps. Each fuel pump has as relief valve set to by-pass fuel from the outlet directly back to the pump inlet if the fuel pressure should exceed 18 PSI. Fuel is supplied only to the engine on the associated side.

b. **Selector Valves**

The selector valves are located on the forward face of number two (No. 2) bulkhead behind the pilot and may *be* set to supply fuel from either right, left or both tanks to either engine.

c. **Fuel Tank Shut-Off Valves**

These are located in the forward part of the pylon accessible from the outside through access doors and are used to shut-off fuel from individual tanks.

The port valve **Must Be Closed** for fuel tanker operations**.**

d. **Electric Boost Pumps**

The electric boost pumps are located inside the pylon on the forward side and controlled by switches in the cockpit. Fuel is supplied from the electric pump only to the engine on the associated side.

e. **Strainers and Drains**

The fuel strainers and drains are also located on the forward side of the pylon. Fuel from the drain cocks is routed to the outside of the aircraft hull.

f. **Primer Solenoid**

The primer solenoid opens a valve which supplies fuel to the top eight cylinders of the engine and is controlled by a switch in the cockpit.

## FUEL SYSTEM

g. **Fire Wall Shut-Off Valve**

This valve is electrically operated and is mounted in the engine nacelle aft of the fire wall and controlled by a switch in the cockpit.

### 1.64 CONSUMPTION AND GRADE

a. For normal flight planning 90 gallons per hour

b. For bombing operations 100 gallons per hour up to eight (8) drops per hour

c. For bombing operations 120 gallons per hour over eight (8) drops per hour

d. A minimum of 150 gallons of fuel must be on board to commence any flight

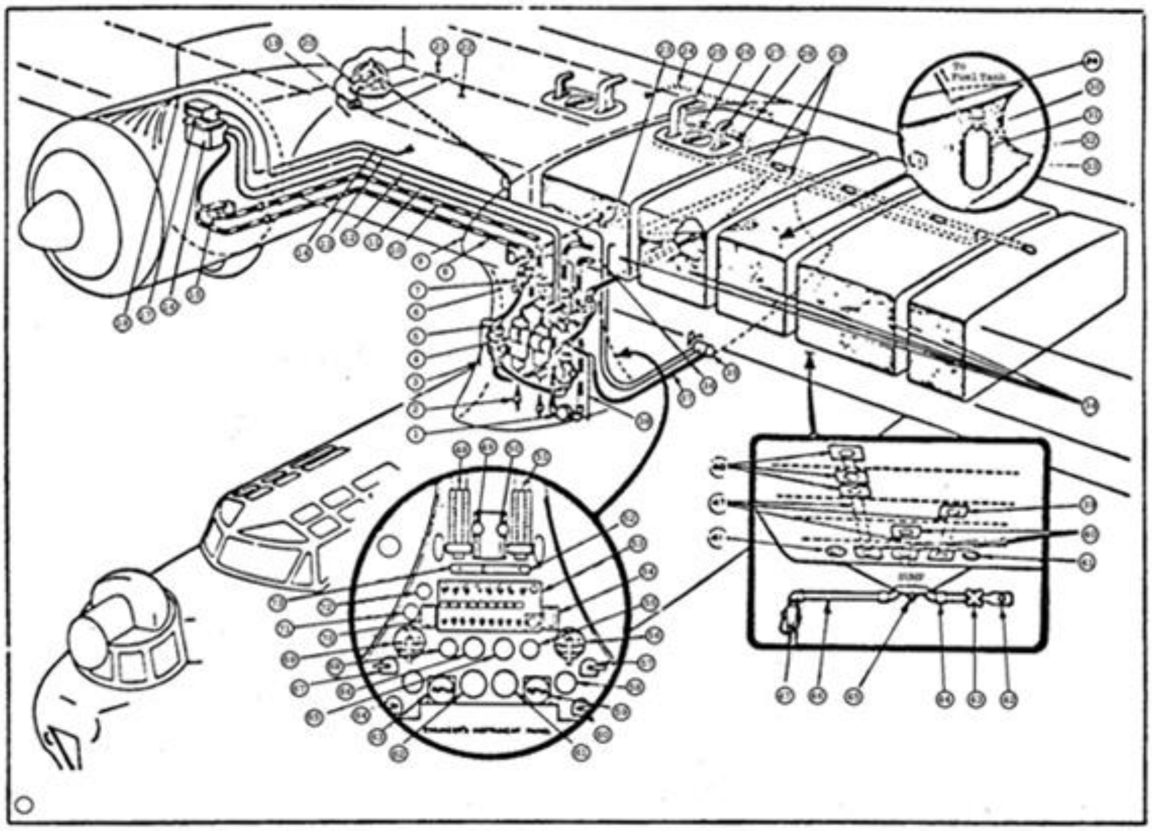
e. Use 100 LL octane or next higher grade

### 1.65 CHECKING FUEL AMOUNT

The most reliable method of checking fuel contents is by means of a dipstick with suitable markings showing contents in gallons. It is important to note that there are two systems of graduation on the Canso fuel tank dipstick. One is for measuring tank contents when the aircraft is on the land and the other when it is afloat. In dipping fuel tanks, care must be taken to avoid bottoming the dipstick on the top of a 1" deep structural flange or rib that runs span-wise on the lower tank surface instead of the actual bottom of the tank. The bottom of the dipstick should be on the forward side of the fuel tank filler opening. Dipping the fuel behind the rib will give a higher reading indicating more fuel in the tank than there is. Fuel tanks of the Canso must be checked by means of the dipstick prior to every flight. The crew member dipping the tanks will also check oil quantities and will take note of the conditions of the cowl gill bolts and brackets on the upper side of the engine as these are not visible from the ground.

## PBY-5A FUEL SYSTEM

MODEL PBY-5A



NOTE: - Item Nos. 20,21,23,24,29,30,31,34,36,47 deleted on civil versions.

1. Cross-feed Selector Valve
2. Strainer Drain Valve
3. Aux Power Unit Fuel Line
4. A.E.L. Unit
5. Fuel Selector Cock
6. Flowmeter
7. Main Fuel Shut-off Valve
8. Cross-feed Fuel Line
9. Center Line of Wing
10. Main Fuel Line to Engine
11. Fuel Pressure Line
12. Vent Line to Pressure Gage
13. Engine Primer Line
14. Vent Line—Tank to Carburetor
15. Engine-Driven Fuel Pump
16. Carburetor
17. Carburetor Elbow Scoop
18. Primer Line Spider
19. Check Valve—Dump Duct
20. ~~Dump Valve~~
21. ~~Dump Duct~~
22. Integral Fuel Tank
23. ~~Dump Valve Control Lever~~
24. ~~Vapor Dilution Line~~
25. ~~Vent Stand Pipe—S.S. Cells~~
26. Filler Neck Cover
27. Vent Stand Pipe—Tank
28. Fuel Tank Manhole Cover
29. ~~S.S. Cells Vent Tubes~~
30. ~~Purging Cylinder Pull Handle~~
31. ~~Purging Cylinder~~
32. Pressure-Relief Line
33. Pressure Relief Disk
34. ~~Self-Sealing Fuel Cells~~
35. Primer Pump
36. ~~Dump Valve Control Cable~~
37. Fuel Line to Primer Pump
38. Fuel Line to Central Heater
39. Fuel Cell Manifold Inspection Window
40. Fuel Cell Manifold Access Doors
41. Sight Gage Inspection Window
42. Main Tank Drain Outlet
43. Shut-off Valve—Tank Drain
44. Main Tank Drain & Refueling
45. Sump Drain Plug
46. Main Fuel Line From Sump
47. ~~S.S. Cell Manifold Lines~~
48. Port Flowmeter
49. Port Fuel Mixture Control
50. Starboard Fuel Mixture Control
51. Starboard Flowmeter
52. Starboard Wobble Pump Handle
53. Engineer-Pilot Visual Signal Panel
54. Starboard Carbtr Air Control
55. Starboard Eng Cyl Temp Gage
56. Starboard Fuel Selector
57. Aux Power Unit Selector
58. Starboard Eng Manifold Pressure Gage
59. Starboard Tachometer
60. Starboard Strainer Drain Selector
61. Starboard Fuel & Oil Pressure Gage
62. Port Fuel & Oil Pressure Gage
63. Port Tachometer
64. Cross-feed Selector
65. Oil Quantity Gage
66. Altimeter
67. Port Strainer Drain Selector
68. Port Eng Cyl Temp Gage
69. Port Fuel Selector
70. Port Carbureter Air Control
71. Outside Air Temp Gage
72. Clock
73. Port Wobble Pump Handle

Fig 27

**FUEL SYSTEM**
**PBY-5A C-FUAW**
**(only)**

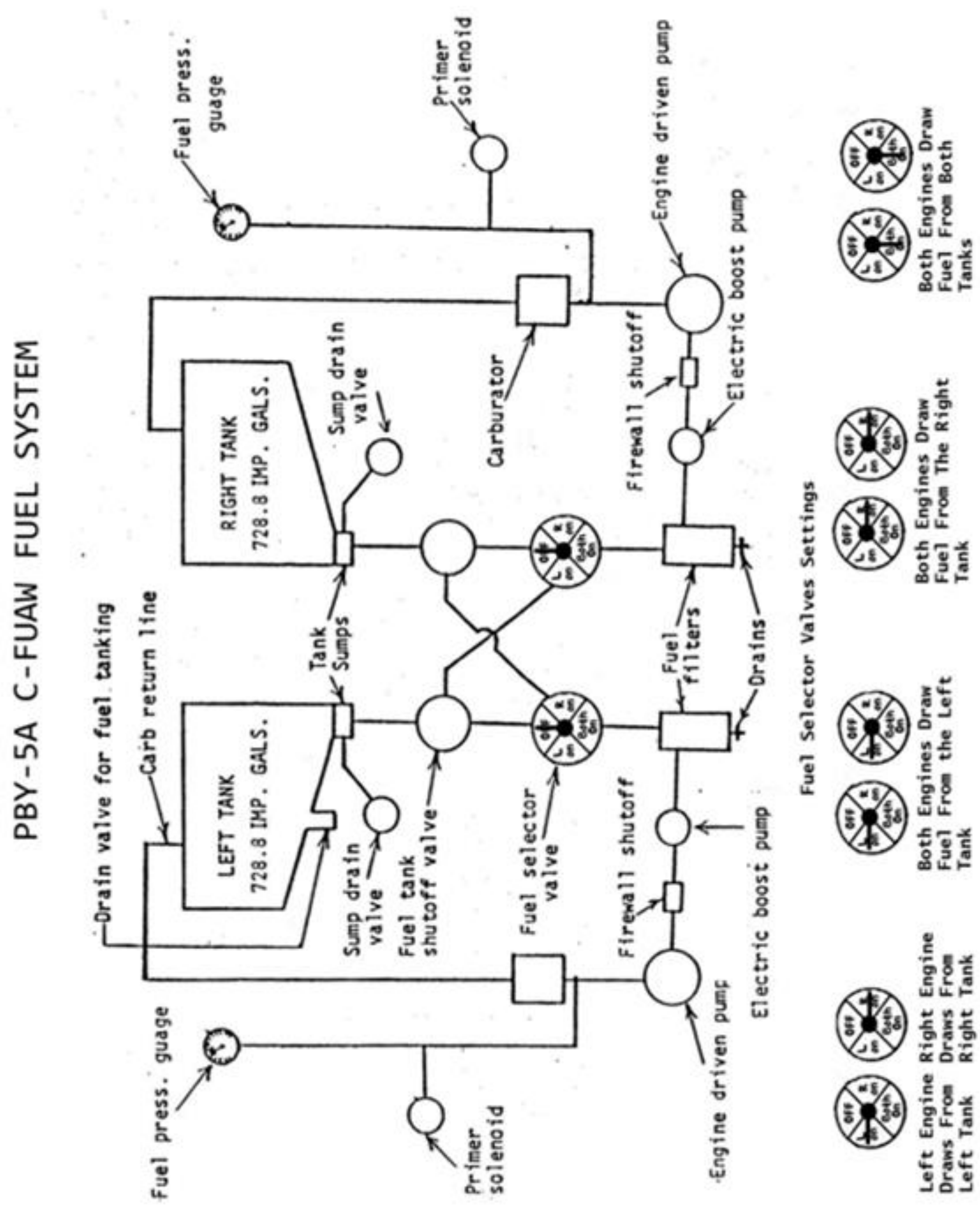
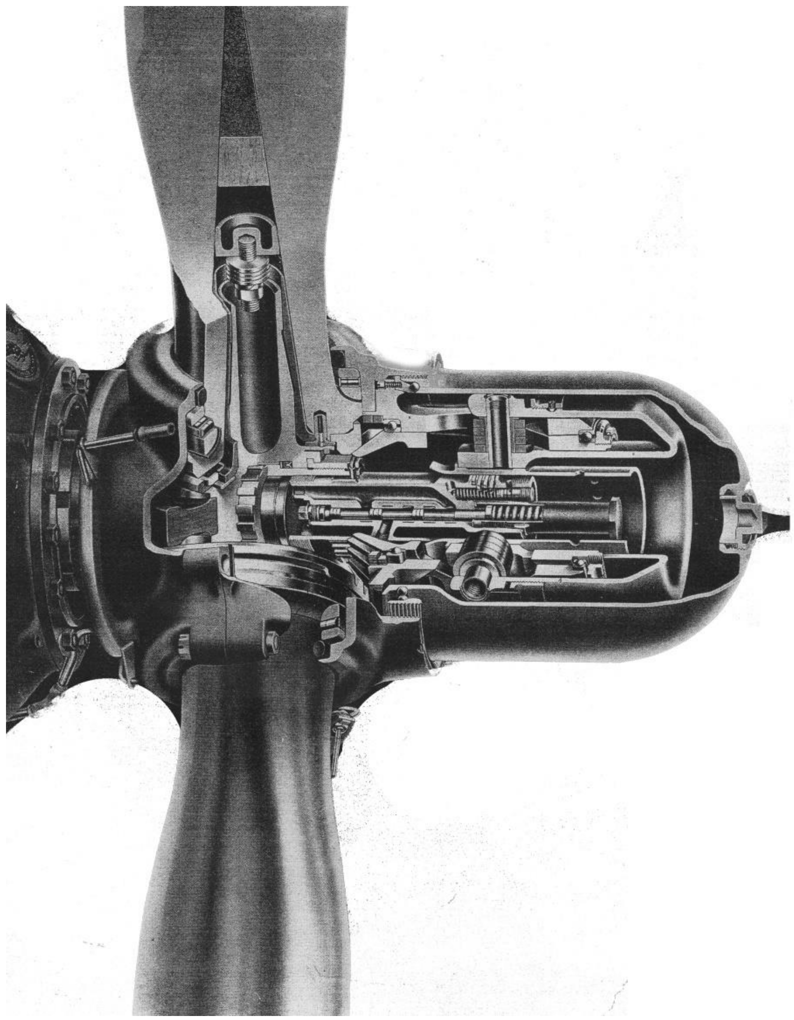



Fig 28

# HAMILTON STANDARD

# PROPELLER



# PROPELLERS

## 1.66 Description

Each engine is equipped with a Hamilton Standard Hydromatic, Quick Feathering, Constant speed, controllable pitch propeller, eleven feet six inches in diameter. The full low pitch is 18 1/2°, the constant speed operating range is approximately 20°, and the full feathering position is 89 1/2°. All settings are taken at the 42-inch blade station.

## 1.67 PROPELLER MECHANISM

The centrifugal force acting on the blades, and engine oil under normal pressure acting on the forward face of the piston in the propeller hub, tends to cause the blades to go into low pitch. Engine oil which has been boosted to a higher pressure by the constant speed governor pump is used to increase the pitch. When the feathering pump is put in operation the oil pressure is increased and the piston overcomes the twisting moment, increasing the pitch until the adjustable mechanical stops are reached where the feathering pump is automatically stopped. About nine seconds are required for the entire feathering operation. When the feathering pump is started again and the blades are in the feathered position, the oil pressure increases to a point where it operates the distributor valve in the propeller hub, allowing the oil to pass to the dome on the forward side of the piston and un-feather the blades.

## 1.68 PROPELLER GOVENORS

The governors are of the fly-ball type, operating a pilot valve which opens and closes a port through which oil is admitted to, and released from the propeller cylinder. As the speed of the engine starts to increase, the fly-balls move out against the governor spring, raising the pilot valve which allows high pressure oil to pass to the cylinder, forcing the blades to a higher pitch. This prevents the engine from running faster. If the engine starts to slow down, the fly-balls move in and drop the pilot valve which allows oil to drain from the propeller cylinder, moving the blades into a lower pitch and preventing the engine from slowing down. Engine oil at 75 psi is boosted to 200 psi by a small gear pump in the base of the governor. This high pressure oil works against the centrifugal twisting moment of the blades and the engine oil pressure on the forward face of the piston, when forcing the blade into higher pitch.

## 1.69 FEATHERING PUMP

The feathering pump take oil from the engine oil tank and delivers it to the propeller causing the piston to move out to the feathered position; the pressure being less than 400 psi. The un-feathering pressure is slightly more than 600 psi. The distributor valve is always in the position for feathering until the oil pressure reaches 600 psi which moves it to the un-feathering position.

## PROPELLERS

### FEATHERING PUMP (continued)

Speed selection is attained by moving the propeller controls on the control pedestal which compress or release the governor spring. The amount of compression of the governor spring determines the speed at which the governor will allow the engine to run, and the more this spring is compressed, the faster will the engine rpm.

### 1.70 FEATHERING OPERATION

Feathering is the term applied when the blades of a propeller are turned to such a high pitch that they lie in the direction of flight. In this position they act as a powerful brake to stop the engine rotation and at the same time offer the least possible drag on the plane.

Feathering is accomplished by supplying oil from the independent source, not controlled by the governor but by a separate feathering motor, to the inboard end of the propeller dome.

This feathering operation is started by depressing the red handled push button switch in the cockpit. This switch is then held closed by its own solenoid, and operates the feathering pump motor solenoid which starts the feathering oil pump operating.

At a pressure of 150 psi the governor valve automatically disconnects the governor from the system by closing the governor port and connects the pump with the inboard end of the propeller cylinder. After the propeller blades have rotated to the full feathered position, the oil pressure builds up to 500 psi on the inboard side of the propeller dome, at which point the pressure cut-out switch operates. The switch breaks the circuit to the cockpit Solenoid switch causing the switch to handle the snap out, thereby breaking the circuit to the feathering pump motor. The feathering operation is then complete.

***It should be noted that the feathering operation may be stopped instantaneously as long as the speed of rotation has not fallen below 600 RPM by pulling out the feathering button.***

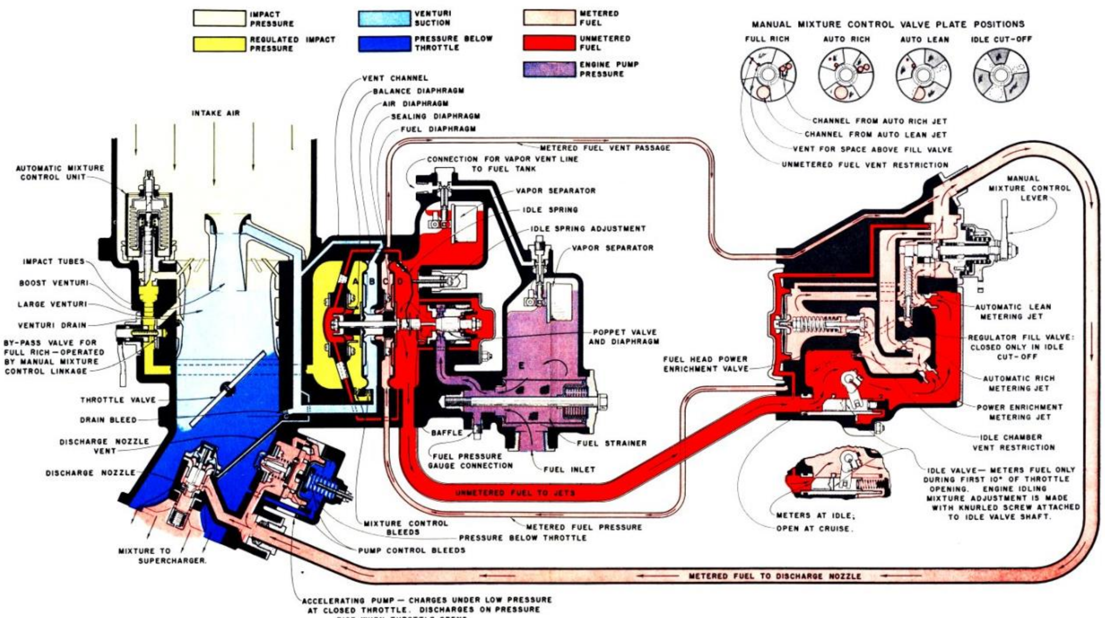
This, as described above, breaks the circuit to the feathering pump motor and stops it.
If the engine RPM are 600 or more at the time the switch handle is pulled, the centrifugal forces on the blades will rotate them towards low pitch. When the rotating speed reaches 800 RPM the governor will take control and the propeller will assume its normal pitch setting.
If the engine speed has fallen below 600 RPM when the feathering operation is stopped, the aerodynamic forces on the blades may exceed the centrifugal forces so that the blades may continue to move towards the full feather position or may windmill in a balanced

## PROPELLERS

### FEATHERING OPERATION (continued)

position. If power is applied, the propeller may be driven at a rotation speed almost up to that at which the governor takes over, depending on the blade angle, when power is applied. If the engine becomes rough or will not continue to respond to an advance of the throttle, it indicates that the blades have assumed an angle too close to their feathered position to permit centrifugal forces and the governor oil pressure to assume control. In such a case, the Feathering Button should be depressed again and the propeller permitted to become fully feathered before trying to un-feather.

**Pby-5A**




Stromberg Injection Carburetor

## CARBURETOR

### 1.71 GENERAL

The Stromberg Model PD12H4 OR PD12H1 Injection Carburetor us a down draft carburetor and is mounted on the engine in exactly the same manner as the standard suction type carburetor. This carburetor differs from the suction type carburetor only in the manner in which the fuel is regulate and delivered to the airstream. In the injection type carburetor, the fuel is pumped (under pressure from the fuel pump) through the carburetor and discharged through the discharge nozzle into the adapter just below the carburetor; whereas in the suction type carburetor the fuel is merely pumped into the float chamber and out the discharge nozzles by the differential between the impact air pressure and the venture suction pressure.

Understanding the construction and operation of he carburetor is made easier by the fact that it is subdivided into separate units, each of which has its individual duty and function.

### 1.72 THROTTLE UNIT

The throttle unit of the injection carburetor is quite similar to that used with conventional float type carburetors. It has a butterfly type throttle valve, a large and a small venture, a throttle balance, provision for mounting an automatic mixture control unit, and a flange for mounting the regular unit. A manually operated valve to by==pass the automatic mixture control and make it inoperative is also included in the throttle body design.

The suction at the throat of the small venture is a measure of the amount of air entering the engine. This suction, when corrected by the automatic mixture control unit for changes in the air density, becomes a measure of mass air flow and is applied to the air diaphragm of the regulator unit to regulate the fuel metering pressure (or head) across the fixed jets in the fuel control unit.

### 1.73 AUTOMATIC MIXTURE CONTROL UNIT

This unit consists of a sealed metallic bellows operating a contoured valve. The bellows is filled with a measured amount of inert gas to make it sensitive to changes in temperature and pressure. The valve, therefore, has a predetermined position for each air density encountered in flight.

## CARBURETOR

### 1.74 MANUAL MIXTURE CONTROL

The carburetor is provided with a manual mixture control which may be set from the control pedestal in the pilots' compartment to give any one of the following positions:

a. **Emergency (Full Rich):**

In this position the automatic mixture control by-pass is open leaving the carburetor without automatic compensation for altitude or temperature. At Sea-Level and Standard Temperature, the fuel flow in TAKE-OFF and CLIMB is approximately the same as the fuel flow in the EMERGENCY position. The increase in richness above TAKE-OFF and CLIMB fuel flow provided by operation in this position increases with altitude.

b. **Take-Off and Climb (Automatic Rich):**

Usual operating position, automatically maintaining the desired fuel / air ratios at all engine speeds and loads, independent of changes in altitude, temperature, propeller pitch, supercharger speed and throttle position. In this setting the port openings are exactly the same as the openings in the EMERGENCY position. At the TAKE-OFF and CLIMB position, however, the by-pass valve is closed thus making the automatic mixture control unit operative.

c. **Cruise (Automatic Lean):**

A leaner setting than TAKE-OFF and CLIMB and suitable for cruising under favourable conditions. This setting may be too lean for good acceleration. When the manual mixture control is in this setting the automatic rich jets are closed allowing fuel to flow only through the automatic lean and the two vent jets. The automatic mixture control is also operative in this position.

d. **Idle-Cut-Off**

Moving the mixture control past CRUISE to the end of its travel closes all ports. This will completely stop all fuel flow to the carburetor nozzle, regardless of fuel pressure or throttle opening. This position is intended principally for stopping the engine without the hazard for backfiring.

e. **Intermediate Positions:**

Each position of the mixture control has a tolerance of about five degrees plus or minus at the carburetor.

# CARBURETOR

### Intermediate Positions (continued)

Between positions there is a fairly uniform transition in its effect on the mixture delivered by the carburetor. Between EMERGENCY and TAKE-OFF and CLIMB the transition varies in its rate and amount, depending upon the density of the air entering the carburetor as affected by temperature and altitude. CRUISE (Automatic Lean) is five to ten percent leaner than TAKE-OFF and CLIMB (Automatic Rich) depending upon the particular carburetor setting. Between CRUISE and IDLE-CUT-OFF, further reduction in mixture strength is attainable by manual control primarily for use when the automatic mixture control may not function properly due to damage. Manual leaning beyond the CRUISE position is not to be done.

Note: Manual leaning may cause severe damage to the engine unless done in accordance with well established instructions.

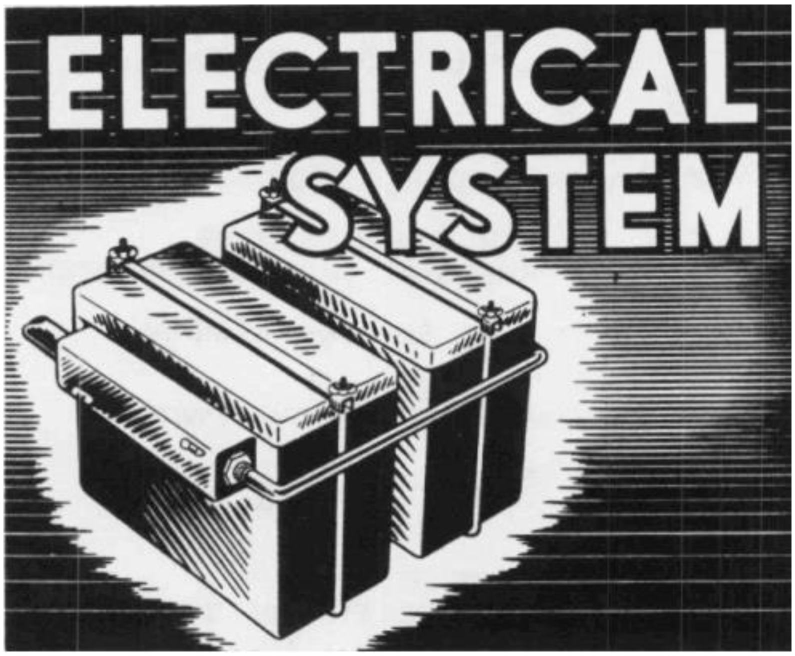
## 1.75 Air Induction System

The carburetor air scoop is of the ramming type wherein a small scoop located on the top forward edge of the engine accessory cowling accepts air from the airstream routing it direct to the carburetor scoop adapter. No provision is made for filtering either cold or hot air intakes.

## 1.76 Carburetor Preheat

The carburetor air scoop of each engine is fitted with a hot air intake door which is operated by a lever on the right hand side of the control pedestal. A single locking lever locks the two carburetor heat levers in any desired position. As the door is opened to hot air intake it proportionally closes off cold air intake, making close control of the carburetor air temperature possible. Preheating of the air intake is accomplished by passing it through a partial enclosure around a section of the exhaust collector ring just ahead of the hot air intake door.

## ELECTRICAL



## ELECTRICAL SYSTEM

1.77 **General**... The electrical system is a 24 - 28 D.C. system; a 200-ampgenerator is mounted on each engine and is protected by reverse current relays mounted in the wing centre section leading edge. Current is supplied by them to the aircraft wiring system and to a 24-volt battery mounted in front of No. 4 bulkhead. Carbon pile regulators located on the front starboard side of No. 4 bulkhead control the output of each generator. There are two ammeters and a voltmeter with a four position switch (right, left, battery and off) in the upper center of No. 2 bulkhead.

1.78 **Electrical Circuit Protection**...All electrical circuits are protected by circuit breakers except the propeller feathering pumps which are protected by fusible links which are not replaceable during flight. For this reason, caution must be used when operating the feathering pumps during cold weather ground operation, and during flight, should not be operated in *excess* of sixty seconds (60 sec.).

Note**:** The circuit breaker is for the feathering button only.

1.79 **The float warning light**... is controlled by the position of the throttle levers or when floats are locked down.

1.80 **An A.P.U**... is also installed to supply power for starting and aircraft servicing. The engine driven generators should not be switched on while the A.P.U. is operating. Provision is made to accommodate a G.P.U. by a plug-in receptacle on No. 4 bulkhead near the entrance hatch.

1.81 **Major units operated by 24 volt D.C**.... power are wing tip floats, carb heat valves, cowl flaps, fuel boost pumps, engine starters, propeller feathering pumps, fire wall shut-off valves, landing lights, strobe and navigation lights, pitot heat, warning lights, auxiliary hydraulic pump and control of the water bombing system.

# CHAPTER 2

## OPERATING LIMITATIONS

# WEIGHT AND BALANCE

## Operational Weight Limitations - as per D.O.T limitations

### 2.0 Model PBY-5A

Aircraft of this type shall comply with the terms listed in the U.S. C.A.A Aircraft Listings 2-548, Section 3, except that for operations conducted entirely within Canada the following deviations shall apply:

a. MAXIMUM WEIGHTS (Note 1)

(1) Provisional Take-Off Weight ..... 30,000 lbs (Note 2)
(2) Landing weight ..... 27,000 lbs

Note:

(a) No additional allowance for de-icers is permitted when operating at these weights
(b) Take-Off weight is limited to maximum landing weight in waves higher than 2 feet. (see - page - Wave height Restrictions)

### 2.1 Model 28-5ACF

Aircraft of this type shall comply with the terms listed in the U.S. C.A.A Aircraft Listings 2-548, Section 3, except that for operations conducted entirely within Canada the following deviations shall apply:

**a. MAXIMUM WEIGHTS (Note 1)**

(1) Provisional Take-Off Weight ..... 30,500 lbs (Note 2)
(2) Landing weight ..... 28,000 lbs

Note:

(a) No additional allowance for de-icers is permitted when operating at these weights
(b) Take-Off weight is limited to maximum landing weight in waves higher than 2 feet. (see - page - Wave height Restrictions)
(c) Seaplane landing weight is limited to 27,000 lbs, unless clipper bow is installed. Ref TC785 Note 5A-2
(d) Landing weight on wheels is limited to 27,000 lbs, when 10-ply rated tires are used. Ref. TC785 Note 6

# WEIGHT AND BALANCE

## 2.2 CENTER OF GRAVITY LIMITATIONS

### a. Reference Data

(1) 28-5ACF – 302 inch forward of step (Bulkhead No.5) at station 0.
(2) PBY-5A – 3 inches aft of bow, at Station 0.

### b. Center of Gravity Range (Gear Down)

(1) Forward Limit (Both Models) ... 22.9% MAC.. Station 242.2 inches

(2) Aft Limit ......... 28-5ACF ……... 28.2% MAC.. Station 251.0 inches

PBY-5A …….. 28.5% MAC.. Station 251.5 inches

## 2.3 Miscellaneous Information

a. Mean Aerodynamic Chord (MAC) .................................... 165.3 inches

b. Leading Edge of MAC ………………………........................... Station 204.4 inches

c. Effect of Gear retraction ……………….......….. ................ Plus 12485 inch pounds

# POWER PLANT

## POWER PLANT

### Pratt & Whitney

### R 1830-92

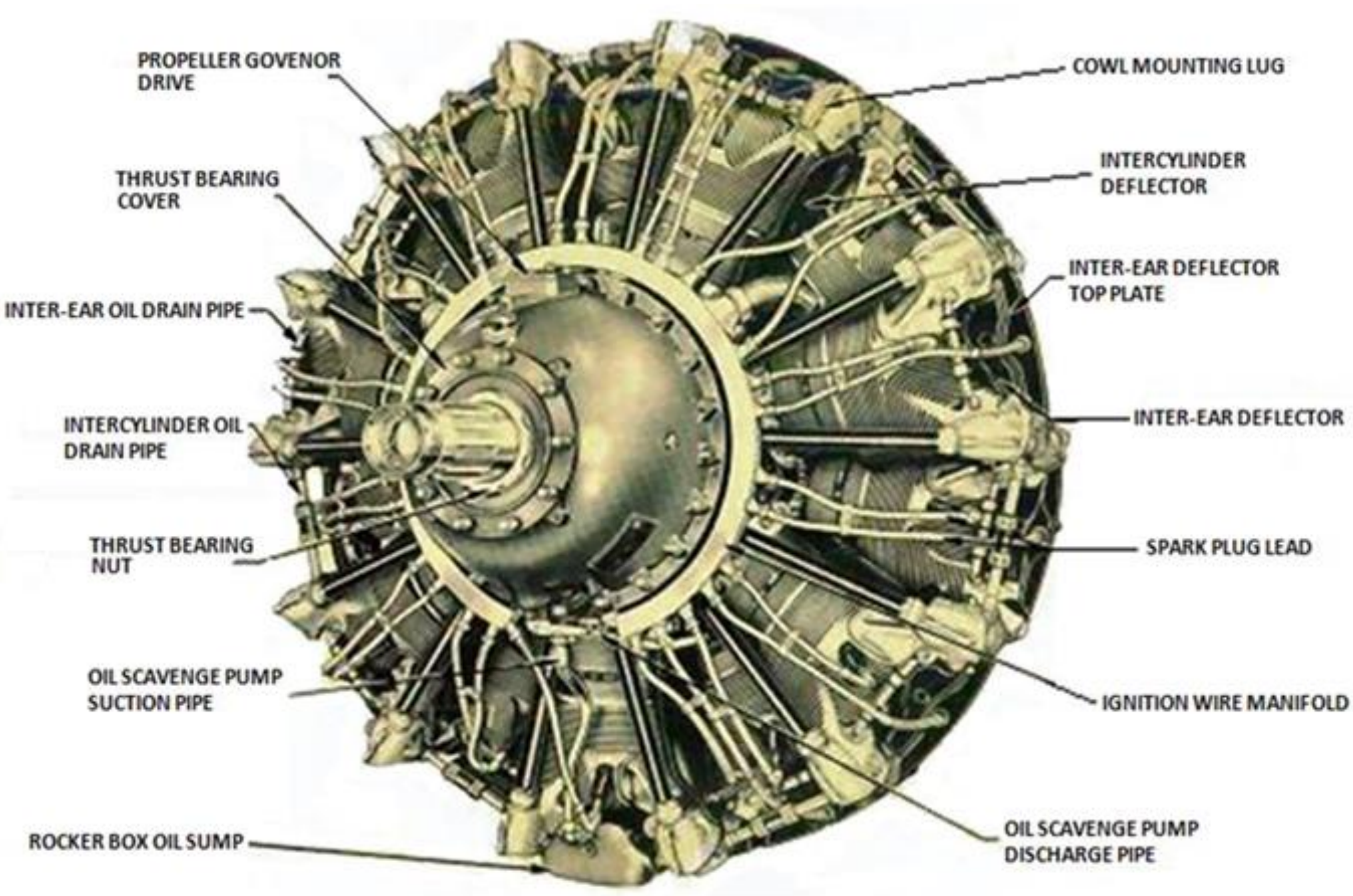



Fig 29

# POWER PLANT

## Pratt & Whitney

**R 1830-92**

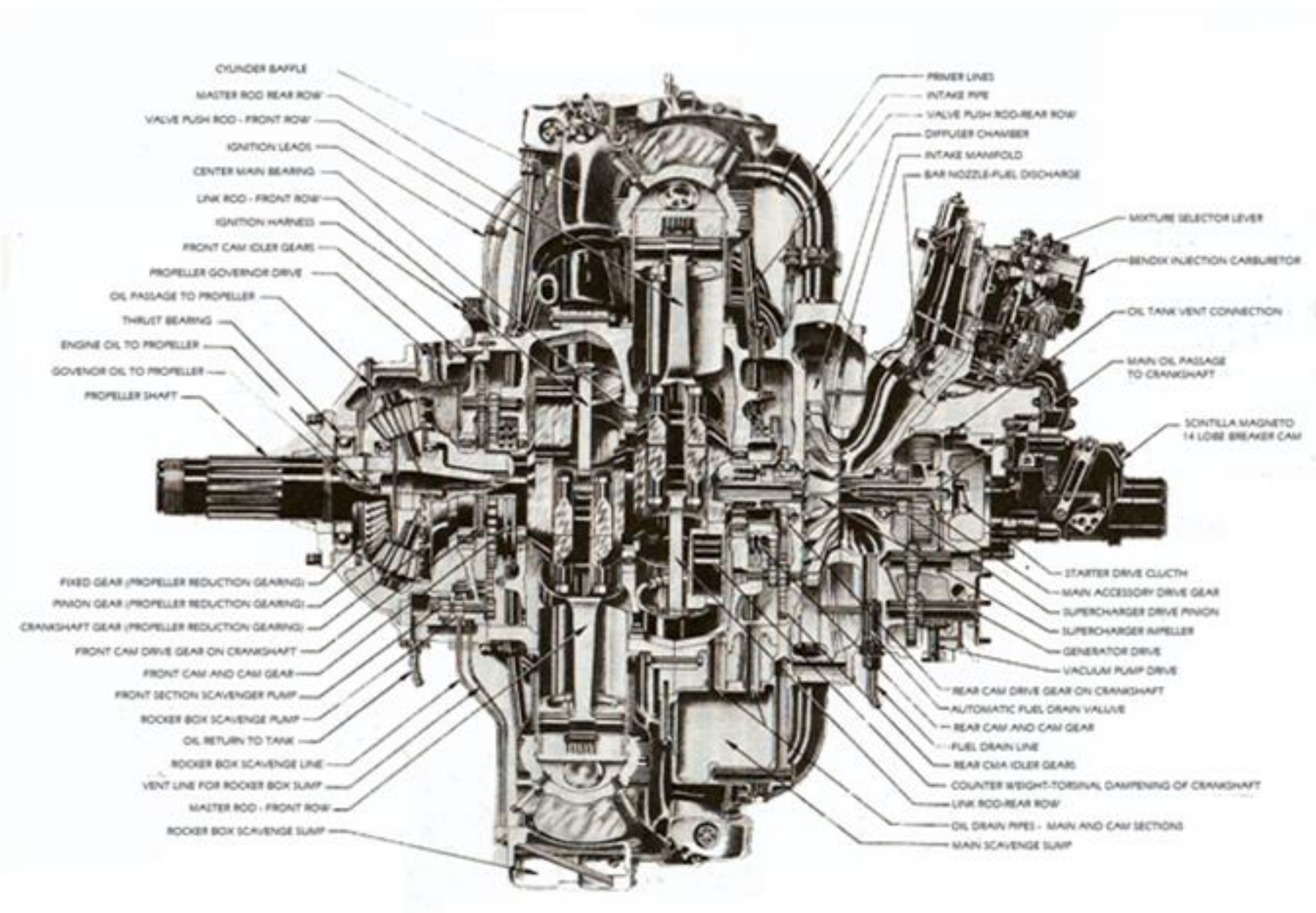



Fig 30

# POWER PLANT

## 2.4 General

Two Pratt and Whitney twin wasp, single stage, single speed supercharged engines are fitted to the PBY-5A aircraft.

The engines are equipped with Bendix Stromberg, model PD12H4 metering injection carburetors. All electrical and ignition systems are radio shielded. The right hand magneto fires the front plugs and the left hand magneto fires the rear plugs. Both magnetos fire 25 degrees before T.D.C.

### a. Limitations

#### (1) Oil Temperature

Maximum Climb............................ 100 C / 212 F
Maximum Cruise .......................... 85 C/ 185 F
Desired ........................................ 60-70 C / 140 F to 158 F
Minimum for Take-Off .................. 50 C/ 122 F
Minimum for Taxi – Run-Up 40 C / 104 F

#### (2) Oil Pressure

Maximum ...................................... 100 PSI
Minimum Cruise ........................... 65 PSI
Desired ......................................... 70/90 PSI

#### (3) Cylinder Head Temperature

Maximum Take-Off ...................... 260 C / 500 F
Maximum Climb .......................... 232 C / 450 F
Desired Cruise............................. 190 C / 374 F
Minimum Take-Off ....................... 120 C / 248 F
Maximum Before Take-Off ......... 200 C / 392 F

#### (4) Fuel Pressure

Maximum ..................................... 18 psi
Maximum .................................... 14 psi
Grade 100 Octane ....................... Low Lead

### b. Power Plant Data

Model .......................................... R1830-92
Type ............................................ Twin Row Radial, Air Cooled
Number of Cylinders .................... 14 – (7 per row)
Master Cylinder ........................... #5 and #12
Bore ............................................. 5.50 inches

## POWER PLANT

**Power Plant Data** (Continued)

| | |
|---|---|
| Stroke ........................................... | 5.50 inches |
| Displacement ................................ | 1830 cubic inches |
| Compression Ratio ........................ | 6.70 : 1 |
| Take-Off Horse Power | 1200 HP @ 2700 RPM @ 48” |

## 2.5 POWER PLANT INSTRUMENT MARKINGS


Fig 31

| INSTRUMENT AND CONDITION | READING | MARKINGS |
|---|---|---|
| Tachometer – RPM | | |
| Maximum Limit | 2700 | Red Radial Line |
| Take-Off or Precautionary Range | 2550 – 2700 | Yellow Arc |
| Minimum Limit | 1700 – 2550 | Red Radial Line |
| Over-speed | 3060 RPM | 30 Sec |
| Manifold Pressure – in. Hg | | |
| Maximum Limit | 48.0 | Red Radial Line |
| Take-Off Precautionary Range | 42.0 – 48.0 | Yellow Arc |
| Normal Operating Range | 20.0 – 42.0 | Green Arc |
| Cylinder Head Temperature - °C | | |
| Maximum Limit | 260 | Red Radial Line |
| Precautionary Range | 232 – 260 | Yellow Arc |
| Normal Operating Range | 120 – 232 | Green Arc |
| Minimum Limit | 120 | Red Radial Line |

## POWER PLANT INSTRUMENT MARKINGS (continued)

| | | |
|---|---|---|
| **Oil Inlet temperature- °C** | | |
| Maximum Limit | 100 | Red Radial Line |
| Precautionary Range | 85 – 100 | Yellow Arc |
| Normal Operating Range | 60 - 75 | Green Arc |
| Minimum Limit | 40 | Red Radial Line |
| | | |
| **Oil Pressure - PSI** | | |
| Maximum Limit | 110 | Red Radial Line |
| Precautionary Range | 90 – 110 | Yellow Arc |
| Normal Operating Range | 65 - 90 | Green Arc |
| Minimum Limit | 65 | Red Radial Line |
| **Fuel Pressure – PSI** | | |
| Maximum Limit | 18 | Red Radial Line |
| Normal Operating Range | 15 - 17 | Green Arc |
| Minimum Limit | 14 | Red Radial Line |
| | | |
| **Carburetor Heat °C** | | |
| Maximum Limit (with pre-heat) | 38 | Red Radial Line |
| Normal Operating Range | 20 - 38 | Green Arc |
| Precautionary Range | 20 - 10 | Yellow Arc |

## POWER PLANT

### 2.6 Power Settings

| | |
|---|---|
| Maximum Take-Off ............................... | 2700 RPM 48” MP (-1.0” for each 10°C below Standard) |
| METO (Maximum Except Take-Off) .... | 2550 RPM 42.5” MP (-.5” for each 10°C below standard based on C.A.T.) |
| First Power Reduction ......................... | 2550 RPM 41” MP |
| Second Power Reduction .................... | 2325 RPM 34” MP |
| Cruise ................................................. | 2050 RPM 29.92“MP (Or as per Cruise Control Chart) |
| Bore ............ ...................................... | 5.50 inches |
| Stroke ................................................. | 5.50 inches |
| Displacement .................................... | 1830 cubic inches |
| Compression Ratio ............................. | 6.70 : 1 |
| Take-Off Horse Power ........................ | 1200 @ 2700 RPM @ 48” MP |

### 2.7 Starting Procedure

All pre-start checks to be completed and A.P.U. On, cowl flaps Open, throttle cracked, if engine has been shut down for less than one hour, crank engine through with the starter, counting seven (7) prop. blades if engine has been shut down for one hour or more count fourteen (14) blades then turn ignition on and prime intermittently until engine starts (cranking time must not exceed thirty seconds (30 sec.) move idle cut-off to auto rich and check for oil pressure rise.

The engine should be warmed up at 1000 - 1200 RPM being careful not to exceed the maximum oil pressure until 50°C oil temperature and at least 120°C head temperature is reached before run-up is carried out.

## POWER PLANT

### 2.8 IGNITION

Each engine is fitted with two separate ignition systems. These systems each include one magneto which can be either a Bendix-Scintilla or an American Bosch, on-off switches,

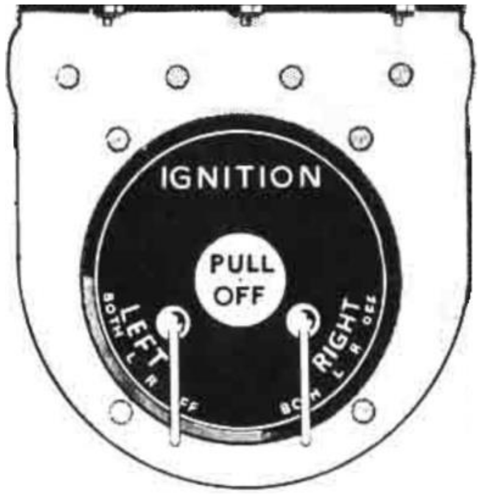



Fig 32

spark plug harness, spark plugs and a booster coil (vibrator type). Normally magnetos are matched up (two of the same type on each engine). The left magneto is on the port side of the engine. Left and right being based on viewing from the rear of the engine. The left hand magneto fires the rear plugs and the right hand magneto fires the front plugs. when {HE ignition switch is set at "L" or "LEFT", the right hand magneto is grounded and the front plugs are dead. The left hand magneto is then not grounded and its plugs (the rear) are live. The Canso is equipped with a master ignition switch for each engine. It is a push-pull type located between and above the magneto switches. Its purpose is to cut out all magnetos momentarily to enable the engines to be idled at a below-normal rpm for slow speed manoeuvrings on water {approaching a mooring buoy for example). This switch is frequently overlooked by inexperienced pilots during starting and is left in the "Off" position by error. Before engine shut—down during the cooling-off idling period, each magneto should be switched to the "Off" position momentarily to ensure that it is functioning. if the engine does not switch off momentarily when this is done, it should be shut down in the usual manner with the mixture control. The faulty magneto is to be reported to the AME in charge. There are two spark plugs in each cylinder head giving an engine total of 28 plugs. The electrode gap is.012" with a tolerance of plus .002" and minus .001"

The magneto distributor blocks carry numbers showing the serial firing order. Number 1 wire goes to number 1 cylinder and number 2 wire goes to the second cylinder in the firing order which is number 10.The firing order of all cylinders in the H-1530-92 is as follows:

1-10-5-14-9-4-13-8-3-12-7-2-11-6

## POWER PLANT

### 2.9 Run-Up

Parking brakes On and aircraft headed into wind if possible, right engine set R.P.M. at 2000 R.P.M. move propeller pitch control to low R.P.M. and return to high R.P.M. after R.P.M. has dropped to approximately 1200 R.P.M. and allow to stabilize again at 2000 R.P.M. move magneto switch to right magneto and return to R.P.M. drop on each magneto (not to exceed 100 R.P.M.) check generator amperage and voltage, open throttle until manifold pressure gauge reaches static pressure as noted on "Before Start" Check List and check R.P.M. (reference R.P.M.). This R.P.M. should remain the same at any altitude providing no changes have been made to the engine, propeller, or carburetor installation. Increase of 2 R.P.M. for each knot of head wind and a decrease of 2 R.P.M. for each knot of tail wind from still air conditions can be expected.

Decrease R.P.M. to 1700 and depress prop feathering button until a 200 R.P.M. drop is noted then pull out feathering button.

Decrease R.P.M. to 1000 and run-up the left engine in the same manner.

With both engines at 1000 R.P.M. pull out ignition master switch momentarily and check that ignition is cut-off to both engines.

All throttle movements should be steady and not too rapid as excessive loads may be imposed and R.P.M. can easily be exceeded if the throttles are opened too rapidly especially when aircraft is moving or in flight.

The maximum R.P.M.s are 2800 if this is exceeded up to 3050 an engineer's signature is required before flight and if 3050 R.P.M. is exceeded the engine must be dismantled for inspection.

Note: The engines must be operated within the limits specified for temperatures, pressures, R.P.M.s and manifold pressure, no over boosting is permitted, cowl flaps must be open for all ground or water running.

## POWER PLANT

### ENGINE OPERATIONAL LIMITS AND POWER RATINGS

### Engine Check Chart - Twin Wasp R-1830 SIC3G Engine

Carburetor: PD-12H4 or PD-12H1
Fuel: Grade 91/98 (10)
Oil: S.U.S at 210 degree F - 100 or 120
Power Settings: Curve Inst 1680-11, 1680-12

FLIGHT OPERATING CONDITIONS / OPERATIONAL LIMITS

| Power Setting | BHP | Mixture Position | Critical Alt. | RPM | Max Manifold Press " HG | Oil Inlet Temp °C Min | Oil Inlet Temp °C Max | Oil Press PSI Min | Oil Press PSI Max | Cyl Hd Temp °C Normal | Cyl Hd Temp °C Max | Max Carb Air Temp °C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Take-Off (2min) | 1200 | Auto-Rich | 4800 | 2700 | 46.0 (48.0 S.L.) | 40 | 100 | 80 | 110 | 150 - 200 (pre Take-Off) | 260 | 38 |
| Normal Rated Power | 1050 | Auto-Rich | 7000 | 2550 | 41.0 (42.5 S.L.) | 40 | 85 (2) | 80 | 110 | 200 or Less | (3) 232 | 38 |
| Normal Rated Alternate | 1000 | Auto-Rich | 10,000 | 2700 | 38.0 (39.0 S.L.) | 40 | 85 (2) | 80 | 110 | 200 or Less | (3) 232 | 38 |
| Max Cruise Power (4) | 700 | Auto-Lean | 14,800 | 2325 | 28.0 (31.0 S.L.) | 40 | 85 (5) | 65 | 90 | 200 or Less | 232 | 38 |
| Approach & Landing | | Auto-Rich | | (6) 2300 | As Req'd | 40 | 85 | 65 | | | 232 | 38 |

OIL PRESSURE: Desired adjustment at 2200 RPM
and 60° Oil Temp: 80 - 90 psi
Normal Operating Range:

2550 - 2700 RPM - 80 - 110 psi
2000 - 2200 RPM - 65 - 100 psi
1600 RPM - 55 - 90 psi
1400 RPM - 40 psi min
Idling - 15 psi min

See Page 4 for notes applicable to the above chart

Fig 33

## POWER PLANT

### 2.10 **GROUND PROCEDURE CHECKS AND LIMITS** – TWIN WASP R1830 S1C30 ENGINE

| PROCEDURE | MIXTURE CONTROL POSITION | PROPELLER CONTROL | THROTTLE CONTROL | OIL INLET TEMP °C MIN | OIL INLET TEMP °C MAX | OIL PRESSURE PSI MIN | OIL PRESSURE PSI MAX | CYL. HEAD TEMP °C MAX (7) |
|---|---|---|---|---|---|---|---|---|
| Pre-Start | MOTOR ENGINE OVER WITH STARTER | | | | | | | |
| Start | Idle-Cut-Off Then Auto Rich | High RPM | 1/10 to 1/4 Open | | | SHOWS ALMOST IMMEDIATELY | | |
| Warm Up | Auto-Rich | High RPM | 1000 RPM | | 85 | 40 | | 200 |
| Ground Test | Auto-Rich | High RPM | (9) | 40 | 85 | 65 | 100 | 232 (8) |
| Stop (7) | Idle-Cut-Off | High RPM | | | 85 | 15 For Idle | | 200 (8) |

Fig 34


APPLICABLE TO LAND

a) Limit on carburetor air temperature applies only when preheat is used.

b) 100 °C allowed during climb

c) 260 °C allowed during climb

d) Max BMEP 140 psi when operating with Auto Lean Mixture. BMEP = 432 X BHP / RPM

e) Desired normal 60°C to 75°C

f) Propeller control setting – not actual RPM

g) Cowl Flaps must be fully open for all ground operations and for at least 15 minutes after shut-down

h) Operations above 200°C should be confined to the minimum possible period of high power operation. Engine should be cooled below 200°C before shut-down

i) Use field barometric pressure. This reading may be obtained by reading the manifold pressure gauge before starting

j) Engine may be operated on Grade 100/130 fuel with no change in rating

# POWER PLANT

## 2.11 PROPELLER SPECIFICATIONS

a. Manufacture ................................ Hamilton Standard

b. Hub Model ................................. 23E50

c. Blade Model ................................ 6477-0

d. Diameter ..................................... Max 11’6”

Min allowable for repairs ..............11’3 3/8”

**Note: No further reduction permitted**

e. Minimum Low Pitch Setting ........ 16° at 42” Station

f. Weight ....................................... 446 pounds each

Note: For interchangeable blade models see Prop. Specs. No. 603 (note 6)

## 2.12 AIRSPEED LIMITATIONS

### a. Maximum Speeds

| CONDITIONS | 28-5AFC T.I.A.S. KTS | PBY-5A T.I.A.S. KTS |
|---|---|---|
| Maximum Glide or Dive – VNE ... 30,500(Note: 1) ................... | 160 | 160 |
| Maximum Level flight or Climb – VNO ............................... | 137 | 147 |
| Maximum for Landing Gear Operation ................................ | 124 | 124 |
| Maximum with Gear Extended ........................................... | 139 | 139 |
| Manoeuvring Speed .......................................................... | 106 | 106 |
| Minimum Control Speed – VMC (3) .................................. | 77 | 76 |
| In Ground Effect ............................................................... | 83 | 80 |

Note: If the aircraft is certified for maximum allowable gross weight of 30,500 lbs the VNE of 160 TIAS shall be observed for all Gross Weights, regardless of allowable increments in airspeed for lesser weights

.

1) The airspeed indicator installation error must not exceed + 5.2 mph at a TIAS of 148 mph.

**POWER PLANT**

## Maximum Speeds (continued)

2) Minimum speed at which aeroplane is controllable in flight with one engine inoperative, its propeller wind-milling, floats and gear up, and the other engine at T.O. power is 76 – 80 kts

## 2.13 AIRSPEED INDICATOR MARKINGS

| CONDITIONS | | 28-5AFC T.I.A.S. KTS | PBY-5A T.I.A.S. KTS |
|---|---|---|---|
| Never exceed Speed | Red Radial | 160 | 160 |
| Precautionary Range | Yellow Arc | 137–160 | 148–160 |
| Normal Range | Green Arc | 87 – 137 | 87 – 147 |

## 2.14 FLIGHT COMPARTMENT PLACARDS

a. **Dash Placards**
The following placards must be installed in front of and in clear view of the pilot.

1) This Airplane must be operated in compliance with the “Approved Operating Limitations” of the Airplane Flight Manual

2) Aerobatic Manoeuvres, including spins are not approve

3) Do not exceed engine temperature limits during water taxiing

Refer to chapter ? for placard requirements in other compartments of the aircraft

## 2.15 MINIMUM CREW

a. **General**

1) A minimum crew of three, i.e., pilot, Co-pilot and Engineer must be carried for all operations if the aircraft has not been modified to eliminate the necessity of a Flight Engineer Station (Conning Tower)

2) Positive means of communications between the flight engineer, if utilized and the pilot and co-pilot must be installed

## 2.16 **MAXIMUM PASSENGERS-PBY-5A** (28-5ACF-as below. Refer to CAR 3.387)

a) When passenger seats are installed in the Model PBY-5A, the number of emergency exits required is as follows:

| No. of persons for which (1) Seats are provided | Minimum Number of exits required |
|---|---|
| 5 or less | 1 |
| 6 to 15 | 2 |
| 16 to 22 | 3 |

Fig 35

Note:Including crew members carried aft of Bulkhead N0. 2

b) When more than one exit is required, the second exit shall not be located on the same side of the cabin as the main entrance door. The original navigators escape hatch in the roof between Bulkheads No. 2 and 4 is acceptable as a third exit only.

c) Bulkhead doors through which passengers would pass in making a normal exit shall be open during take-off and landing.

## PBY-5A PERFORMANCE INFORMATION

## 2.17 STALLING

In general, the stalling characteristics are very good and require very little effort on the pilot's part during the stall and recovery. Stalling speeds vary as the square root of the gross weight of the airplane, with or without power, the airplane settles as it approaches the stall; the stall is very gradual, showing no tendencies to whip. An indication of the approaching stall is a slight tail shake increasing as the stall becomes more evident.

## POWER PLANT

### 2.18 STALLING SPEEDS

Stalling speeds for different gross weights for various angles of bank:

| DEGREE OF BANK | 28000 POUNDS | 30500 POUNDS |
|---|---|---|
| 0 | 63.5 Knots | 66.5 Knots |
| 10 | 64.5 Knots | 67.5 Knots |
| 20 | 65.5 Knots | 68.5 Knots |
| 30 | 68.5 Knots | 71.5 Knots |
| 40 | 73.0 Knots | 76.0 Knots |
| 50 | 70.5 Knots | 83.0 Knots |
| 60 | 90.0 Knots | 94.0 Knots |

Fig 36

a. For clean condition (gear up, floats up) and gross weight of 27,000 pounds, with cowl flap 1/4 open and power off, the indicated stalling speed is approximately 63 knots with a sinking rate of 300/400 feet per minute.

b. With cowl flap 1/4 open and power on, the indicated stalling speed is approximately 62 knots with a sinking rate of 300 feet per minute.

c. For dirty conditions (gear down, floats down) and gross weight of 27,000 pounds, with cowl flaps 1/4 open and power off, the indicated stalling speed is approximately 67 knots with a sinking rate of 400 feet per minute.

### 2.19 CRITICAL CROSS WIND DEMONSTRATION

Take-off and landings have been demonstrated for both seaplane and landplane operation, up to cross-winds whose component (90 degrees to take-off path) is 15 mph, with no abnormal handling characteristics being encountered.

## PBY-5A PERFORMANCE INFORMATION

### 2.20 WAVE HEIGHT LIMITATIONS

Take-Off. Landings or On-The –Step taxiing shall not be attempted in sea conditions which produce waves greater that 2 (two) feet in height.

### 2.21 POWER CHARTS – TWIN WASP (R1830) S1C3G

TAKE-OFF POWER – 1200 BHP

Min. Octane 91/98 Take-Off Manifold Pressure 2700 RPM

| Pressure Altitude Feet | °C CARBURETOR AIR TEMPERATURE – VARIATION FROM STANDARD °C | | | | | |
|---|---|---|---|---|---|---|
| | -30 to -20 | -20 to -10 | -10 to 0 | 0 to 10 | 10 to 20 | 20 to 30 |
| S.L. | 46.0 | 46.5 | 47.0 | 47.5 | 48.0 | 48.5 |
| 1000 | 45.7 | 46.2 | 46.7 | 47.2 | 47.7 | 48.2 |
| 2000 | 45.4 | 45.9 | 46.4 | 46.9 | 47.4 | 47.9 |
| 3000 | 45.0 | 45.5 | 46.0 | 46.5 | 47.0 | 47.5 |
| 4000 | 44.7 | 45.2 | 45.7 | 46.2 | 46.7 | 47.2 |
| 4800 | 44.5 | 45.0 | 45.5 | 46.0 | 46.5 | 47.0 |

Fig 37

### 2.22 Pre Take-Off Control Settings

a. Mixture ...................................... Auto Rich
b. Propeller ................................... High RPM
c. Carburetor Heat ......................... Cold
d. Cowl Flaps ................................ Full open, until immediately before Take-off

### 2.23 Limits During Take-Off (2 minutes)

a. Cylinder Head Temp .................. 260° Maximum
120° Minimum
150 - 200° Desired before Take-Off To
b. Oil Inlet Temp ............................ 100° Maximum
40° Minimum
c. Oil Pressure ............................... 110 psi Maximum
80 psi Minimum
d. Fuel Pressure ............................. 14 psi Minimum

# PBY-5A PERFORMANCE INFORMATION

## 2.24 Normal Rated Power – Twin Wasp (R-1830) S1C3G

-1050 BHP-

Min. Octane 91/98 Rated Manifold Pressure 2550 RPM

| Pressure Altitude Feet | °C CARBURETOR AIR TEMPERATURE – VARIATION FROM STANDARD °C | | | | | |
|---|---|---|---|---|---|---|
| | -30 to -20 | -20 to -10 | -10 to 0 | 0 to 10 | 10 to 20 | 20 to 30 |
| S.L. | 40.5 | 41.0 | 41.5 | 42.0 | 42.5 | 43.0 |
| 2000 | 40.1 | 40.6 | 41.1 | 41.6 | 42.1 | 42.6 |
| 4000 | 39.9 | 40.4 | 40.9 | 41.4 | 41.9 | 42.4 |
| 6000 | 39.7 | 40.2 | 40.7 | 41.2 | 41.7 | 42.2 |
| 7000 | 39.6 | 40.1 | 40.6 | 41.1 | 41.6 | 42.1 |

Fig 38

Note: Above the full throttle altitude, approximately 7,000 feet, an alternate rated power setting is available using 2700 RPM and a maximum of 38" M.P. up to 10,000 feet. This setting delivers 1000 BHP.

## 2.25 Control Settings

a. Mixture .................... Auto Rich
b. Propeller .................. 2550 RPM
c. Throttle ................... As per Chart
d. Carburetor Heat ............ As required

## 2.26 Limits During Take-Off (2 minutes)

a. Cylinder Head Temp......... 260° Maximum during Climb
232° Maximum during Cruise
200° or less desired
b. Oil Inlet Temp ............. 85° Maximum (100°)allowed during climb
40° Minimum
c. Oil Pressure ............... 110 psi Maximum
80 psi Minimum
d. Fuel Pressure .............. 14 psi Minimum
e. Carburetor Heat ............ 38°C Maximum if preheat is used.

## PBY-5A PERFORMANCE INFORMATION

### 2.27 CLIMB POWER SETTINGS AND LIMITS – (R-1830) S1C3G

810 – 860 BHP Constant Manifold Pressure

| Pressure Altitude Feet | Mixture Control Position | BHP | RPM | Manifold Pressure IN. Hg |
|---|---|---|---|---|
| | | | | |
| S.L. | Auto-Rich | 810 | 2300 | 35.0 |
| 5000 | Auto-Rich | 835 | 2300 | 35.0 |
| 8700 | Auto-Rich | 860 | 2300 | 35.0 (FT) |
| 9500 | Auto-Rich | 840 | 2300 | 34.0 (FT) |
| 10500 | Auto-Rich | 810 | 2300 | 33.0 (FT) |

Fig 39

a. Climb shall normally be conducted at the above settings, and at approximately 130 mph IAS
b. Increase manifold pressure 0.5 in. Hg for every 10°C rise of carburetor temp from standard altitude temp, or decrease 0.5 in. Hg for each 10°C that carburetor air temp is below standard altitude temp, up to full throttle altitude

### 2.28 Climb Limits

a. Cylinder Head Temp .................... 260°C Maximum during climb
232°C Maximum during cruise
200°C or less Desired
b. Oil Inlet Temp ............................. 100°C Maximum during climb
85°C Maximum during cruise
40°C Minimum
c. Oil Pressure .................. .............. 65 psi Minimum
d. Fuel Pressure .............................. 14 psi Minimum
e. Carburetor Heat .......................... 38°C Maximum if preheat is used. No limit if preheat control is in the COLD Position

2.29 **Alternate Climb Power** – At the discretion of the pilot and as circumstances require, the following additional climb power settings may be used:

a. 640 – 700 BHP Climb as per Engine Operation table Page 45 or

b. 1050 BHP Rated Power as per page (Emergency Only)

# PBY-5A PERFORMANCE INFORMATION

## 2.30 Establishing Cruise

a. After climb to desired altitude, trim the aircraft for level flight.

b. The Engine Check Chart specifies a maximum cruise power of 700BHP at 2325rpm with Auto-Lean mixtures. While it is possible to use this power and be within the maximum limits, experience obtained over many years indicates that cruise operation in excess of 600BHP and 2050rpm tends both to reduce engine overhaul life and increases the frequency of malfunction to a significant degree. Consequently, Pratt and Whitney Aircraft recommend that cruise power be limited to 600BHP or less and that 2050rpm be used at all powers for normal cruising.

c. Extract the cruise power manifold pressure settings from the applicable cruising power charts as follows:

   1) If the aircraft gross weight at cruising altitude is 24,500 lbs or less use the 550 BHP Chart
   2) If the aircraft gross weight at cruising altitude is 24,500 lbs or more use the 600 BHP Chart

d. Retain climb power while the aircraft is accelerating to anticipated air speed

e. Close the cowl flaps as cruising cylinder head temperatures are obtained with increase air speed

f. Adjust the throttles to the approximate MP" selected for cruise

g. Reduce engine speed to cruise RPM – 2050

h. Apply carburetor heat as required. (Recommended 15 - 25°C)

i. Re-adjust throttles as required to the selected cruise MP"

j. Move mixture controls to Auto-Lean after engines have cooled to or slightly below normal temperatures for level flight.

## 2.31 Cruise Engine Limits

| | | |
|---|---|---|
| a. | Cylinder Head Temperature .................. | 232°C Maximum during climb<br>200°C or less recommended |
| b. | Oil Inlet Temperature ............................ | 85°C Maximum during climb<br>40°C Minimum<br>60 - 75°C Desired normal |
| c. | Oil Pressure ......................................... | 90 psi Maximum |
| d. | Fuel Pressure ..................................... | 14 psi Minimum |
| e. | Carburetor Heat .................................. | 38°C Maximum if preheat is used. No limit if preheat control is in the COLD Position |

## PBY-5A PERFORMANCE INFORMATION

### 2.32 550 BHP CRUISING CHART

Min. Octane 91/98 Manifold Pressure Inches Hg 2050 RPM

| Pressure Altitude Feet | °CCARBURETOR AIR TEMPERATURE °C – VARIATION FROM STANDARD °C | | | | | |
|---|---|---|---|---|---|---|
| | -30 to -20 | -20 to-10 | -10 to 0 | 0 to 20 | 10 to 20 | 20 to 30 |
| | | | | | | |
| S.L. | 26.5 | 27.0 | 27.5 | 28.0 | 28.5 | 29.0 |
| 2000 | 26.2 | 26.7 | 27.2 | 27.7 | 28.2 | 28.7 |
| 4000 | 26.0 | 26.5 | 27.0 | 27.5 | 28.0 | 28.5 |
| 6000 | 25.8 | 26.3 | 26.8 | 27.3 | 27.8 | 28.3 |
| 8000 | 25.6 | 26.1 | 26.6 | 27.1 | 27.6 | 28.1 |
| 10000 | 25.4 | 25.9 | 26.4 | 26.9 | 27.4 | 27.9 |
| 12000 | 25.2 | 25.7 | 26.2 | 26.7 | 27.2 | 27,7 |

Fig 40

### 2.33 600 BHP CRUSING CHART

Min. Octane 91/98 2050 RPM

| Pressure Altitude Feet | °C CARBURETOR AIR TEMPERATURE °C – VARIATION FROM STANDARD °C | | | | | |
|---|---|---|---|---|---|---|
| | -30 to -20 | -20 to-10 | -10 to 0 | 0 to 10 | 10 to 20 | 20 to30 |
| S.L. | 28.5 | 29.0 | 29.5 | 30.0 | 30.5 | 31.0 |
| 2000 | 28.2 | 28.7 | 29.2 | 29.7 | 30.2 | 30.7 |
| 4000 | 28.0 | 28.5 | 29.0 | 29.5 | 30.0 | 30.5 |
| 6000 | 27.8 | 28.3 | 28.8 | 29.3 | 29.8 | 30.3 |
| 8000 | 27.6 | 28.1 | 28.6 | 29.1 | 29.6 | 30.1 |
| 10000 | 27.4 | 27.9 | 28.4 | 28.9 | 29.4 | 29.9 |
| 12000 | 27.2 | 27.7 | 28.2 | 28.7 | 29.2 | 29.7 |

Fig 41

## PBY-5A PERFORMANCE INFORMATION

### 2.34 Cruise Control Settings

| | |
|---|---|
| Mixture ................................................................ | Auto Lean |
| Propeller ............................................................ | 2050 RPM |
| Throttle ............................................................... | As per above Chart |
| Carburetor Heat ................................................ | As required 15 – 25° |

### 2.35 ENROUTE EMERGENCY POWER SETTINGS – (R-1830) S1C3G

**Control Settings**

| | |
|---|---|
| Mixture ............................................................. | Auto Rich |
| Propeller ..... Below 9000 feet ......................... | 2550 rpm Maximum |
| Above 9000 feet ............................................ | 2700 rpm maximum |
| Throttle ...... with 2550 rpm ............................ | 41.0 in. Hg Maximum |
| With 2700 rpm .............................................. | 38.0 in. Hg Maximum |
| Carburetor Heat .............................................. | As required |

### 2.36 En route Emergency Power Limits

| | |
|---|---|
| Cylinder Head Temp ....................................... | 260°C Maximum during climb<br>232°C Maximum during cruise<br>200°C or less Desired |
| Oil Inlet Temp ................................................ | 100°C Maximum during climb<br>85°C Maximum during cruise<br>40°C Minimum |
| Oil Pressure .................................................... | 65 psi Minimum |
| Fuel Pressure ................................................ | 14 psi Minimum |
| Carburetor Heat ............................................. | 38°C Maximum if preheat is |

Note: If more power is required for a short interval, increase rpm not to exceed 2700 and manifold pressure not to exceed 48 in. Hg

## PBY-5A PERFORMANCE INFORMATION

### 2.37 Intermediate Single Engine Settings

a. Up to Rated Power may be used for single engine cruise

b. The fuel flows listed below are for an altitude of 5000 feet. Maintaining the same settings at altitudes greater than 5000 feet will result in an increase of fuel flow of approximately ½ GPH per engine per 1000 feet.

| Mixture | BHP | RPM | MANIFOLD PRESSURE | GPH (2 ENGINE) |
|---|---|---|---|---|
| Auto Rich | 1050 | 2550 | 41.0 | 200 |
| Auto Rich | 930 | 2550 | 37.0 | 172 |
| Auto Rich | 880 | 2550 | 35.0 | 156 |
| Auto Rich | 870 | 2450 | 35.0 | 150 |
| Auto Rich | 850 | 2350 | 35.0 | 140 |
| Auto Rich | 820 | 2250 | 35.0 | 131 |

Fig 42

### 2.38 ENGINE operation – CARBURETOR ICING

a. **ICING CONDITIONS**

1) Visible moisture at temperatures below freezing, either in the form of clouds or as precipitation, forms impact ice in the air scoop and in or on the carburetor metering elements
2) High humidity with a carburetor air temperature below 3°C forms throttle ice on the carburetor throttle plate at part throttle
3) High humidity with carburetor air temperatures in the range from 0°C to 32°C forms evaporation ice in the region between the carburetor and the impeller. Be alert for such icing which occurs at relatively high temperatures in sultry weather not generally associated with ice formation
4) Prolonged exposure to severe low temperature conditions, from approximately minus 5°C and below, can lower the fuel temperature to the point where it may cause icing in the internal passages of the carburetor during subsequent operation in high humidity atmosphere. This is known as mixture controls bleed icing and is usually accompanied by severe enrichment of the mixture. It is most apt to occur if the aircraft is cold socked for many hours, possibly parked on the ramp. Experience indicates that it is not likely to occur if the fuel temperature entering the carburetor is at or above 0°C.

b. **ICING PREVENTION**

1) It is preferable to prevent icing rather than have to rely on more drastic de-icing procedures once it has occurred. When icing conditions are anticipated or encountered:

(a) Set mixture control in Auto Rich

(b) Apply preheat to maintain 32°C (or up to 38°C maximum) carburetor air temperature.

(c) After carburetor air temp and engine operation have stabilized, adjust mixture to desired setting

(d) In flight it is desirable to use preheat at least 15 min before entering known or anticipated icing conditions, because preheat is most effective for prevention of ice and accompanying power loss if applied and maintained considerably in advance of encountering these conditions. As a precaution, therefore, when atmospheric conditions are conducive to the formation of carburetor icing, it is recommended to conduct the entire cruise operation with the preheat control set to maintain between 15°C to 25°C carburetor heat, and to be prepared to increase the temp to 32°C (38°C maximum) if required.

(e) To prevent icing during take-off, maintain 32°C up to 38°C maximum carburetor air temp during warm-up and ground running, but set preheat COLD several min before take-off. Keep preheat COLD for take-off and be ready to apply 32°C (or up to 38°C maximum) carburetor air temp for ice protection during climb.

## 2.39 ICING INDICATIONS

(a) When operating in icing conditions without carburetor preheat, there may be little warning that icing has occurred until it has produced sufficient ice to impair engine performance seriously. The following indications may accompany icing:

1) Decreasing power and airspeed at constant throttle and rpm, either with or without an accompanying decrease of manifold pressure. If there is no decrease in manifold pressure, the power loss is probably due to leaning or enrichment of the carburetor. If there is a reduction in manifold pressure, the power is probably due to restricted air flow through the induction system.

2) A rapid loss of power, possibly accompanied by rough or erratic engine operation, indicates severe leaning or enrichment of the carburetor.

## PBY-5A PERFORMANCE INFORMATION

### ICING INDICATIONS (continued)

3) Uneven response of manifold pressure to changed throttle settings die to ice jamming or sticking the carburetor throttle.
4) Erratic engine operation due to ice on metering elements, with resulting change in mixture or mixture distribution to the cylinders.

### 2.40 DE-ICING PROCEDURE

a) If icing occurs, use the following de-icing procedures, in sequence to eliminate the ice:
   1) Shift mixture control to Auto Rich
   2) APPLY FULL CARBURETOR PREHEAT CAPACITY, HOLD FULL PREHEAT ON for 30 seconds. CAUTION: If appreciable engine icing develops, the loss of power will be accompanied by a loss of preheat capacity, sharply reducing the effectiveness of full preheat in eliminating ice.
   3) Check whether manifold pressure is restored by slowly returning preheat control towards COLD. If the increase in manifold pressure from full hot to full cold is consistent on successive checks, the ice is probably eliminated. Adjust preheat to maintain 32°C carburetor air temperature.

b) When it is known that the temperature of the fuel is well below freezing which may cause power loss due to mixture control bleed icing:
   1) Adjust preheat control to maintain maximum permissible preheat (38°C). This type of icing may require constant 38°C preheat for a considerable period of time (5 to 15 min or longer) before normal operation returns.
   2) Readjust preheat control to maintain 32°C carburetor air temp.

# FUEL DISTRIBUTION

## 2.41 GENERAL

a. For normal operation fuel shall be equally distributed between the left and right tanks

b. The minimum required Block Fuel for any flight shall not be less than 160 Imperial Gallons.

## 2.42 WHEN OPERATED AS A FUEL OIL TANKER

a. When operated as a fuel tanker, the Right tank only will be available for engine fuel supply. The Left tank must be isolated from the engine fuel system by disconnecting the main connector hose at the Shut-Off Valve

b. The weight of fluid carried in the isolated tank must not exceed the weight of a full tank of aviation fuel; ie., 728.8 I.G. X 7.2 lbs/gallon: 5247 pounds.

c. When operated as a tanker, the following placards must be displayed:

(1) In Flight Engineers Compartment (Conning Tower) – “When used as an Oil Tanker the PORT (Left) tank shall be isolated from the main fuel system by disconnecting the main connector hose at the shut-off valve.

(2) In Pilots Compartment – (adjacent to Fuel Selector)- “Left tank Isolated”

(3) By the Right Fuel Tank Filler Cap: - “Aviation Gas Only in this Tank”.

(4) By the Left Fuel tank Filler Cap: - “Fuel Oil Only – Maximum 5247 pounds”.

## FUEL DISTRIBUTION

### 2.43 MINIMUM REQUIRED FUEL – 28-5ACF and PBY-5A

a. Calculated distance to be flown to destination
b. Add distance to alternate, if required
c. If IFR, add 15 gallons for 1st – letdown allowance
d. Add 15 gallons for each enroute stop made before re-fuelling
e. Add 10 gallons for taxi and run-up

### DISTANCE VS. FUEL REQUIREMENTS

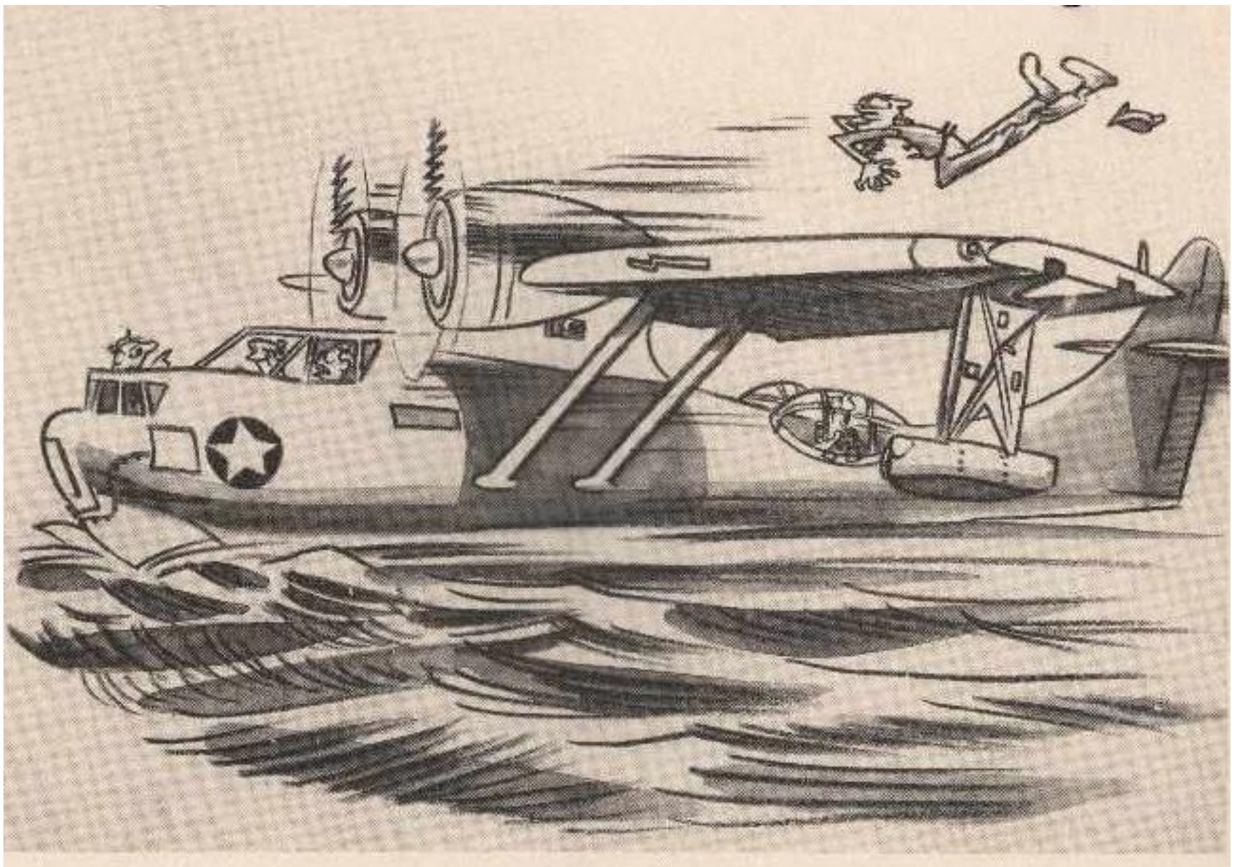
| STATUTE MILES | HEAD WIND COMPONENT | | | STATUTE MILES | HEAD WIND COMPONENT | | |
|---|---|---|---|---|---|---|---|
| | ZERO | -10 | -20 | | ZERO | -10 | -20 |
| 135 | 150 | 160 | 170 | 585 | 450 | 460 | 470 |
| 150 | 160 | 170 | 180 | 600 | 460 | 470 | 480 |
| 165 | 170 | 180 | 190 | 615 | 470 | 480 | 490 |
| 180 | 180 | 190 | 200 | 630 | 480 | 490 | 500 |
| 195 | 190 | 200 | 210 | 645 | 490 | 500 | 510 |
| 210 | 200 | 210 | 220 | 660 | 500 | 510 | 520 |
| 225 | 210 | 220 | 230 | 675 | 510 | 520 | 530 |
| 240 | 220 | 230 | 240 | 690 | 520 | 530 | 540 |
| 255 | 230 | 240 | 250 | 705 | 530 | 540 | 550 |
| 270 | 240 | 250 | 260 | 720 | 540 | 550 | 560 |
| 285 | 250 | 260 | 270 | 735 | 550 | 560 | 570 |
| 300 | 260 | 270 | 280 | 750 | 560 | 570 | 580 |
| 315 | 270 | 280 | 290 | 765 | 570 | 580 | 590 |
| 330 | 280 | 290 | 300 | 780 | 580 | 590 | 600 |
| 345 | 290 | 300 | 310 | 795 | 590 | 600 | 610 |
| 360 | 300 | 310 | 320 | 810 | 600 | 610 | 620 |
| 375 | 310 | 320 | 330 | 825 | 610 | 620 | 630 |
| 390 | 320 | 330 | 340 | 840 | 620 | 630 | 640 |
| 405 | 330 | 340 | 350 | 855 | 630 | 640 | 650 |
| 420 | 340 | 350 | 360 | 870 | 640 | 650 | 660 |
| 435 | 350 | 360 | 370 | 885 | 650 | 660 | 670 |
| 450 | 360 | 370 | 380 | 900 | 660 | 670 | 680 |
| 465 | 370 | 380 | 390 | 915 | 670 | 680 | 690 |
| 480 | 380 | 390 | 400 | 930 | 680 | 690 | 700 |
| 495 | 390 | 400 | 410 | 945 | 690 | 700 | 710 |
| 510 | 400 | 410 | 420 | 960 | 700 | 710 | 720 |
| 525 | 410 | 420 | 430 | 975 | 710 | 720 | 730 |
| 540 | 420 | 430 | 440 | 990 | 720 | 730 | 740 |
| 555 | 430 | 440 | 450 | 1005 | 730 | 740 | 750 |
| 570 | 440 | 450 | 460 | 1020 | 740 | 750 | 760 |
| S.M. | IMPERIAL GALLONS | | | S.M. | IMPERIAL GALLONS | | |

The above figures include: 1 hour of reserve fuel (45 minutes Minimum). Climb and heater allowance.

Fig 43

# CHAPTER 3

## PERFORMANCE LIMITATIONS



Dilbert never throttled back

# PERFORMANCE LIMITATIONS AND INFORMATION

## 3.0 GENERAL

a. THE Consolidated PBY-5A and 28-5ACF aircraft operated by Pacific Flying Boats Ltd. On passenger and cargo services shall be subject to limitations stipulated in Air Navigation Order Series VII, No. 2, Standards and Procedures for Air Carriers Operating large aircraft.

## 3.1 CROSS-WIND VELOCITY ON RUNWAY

a. Take-Offs and landings have been demonstrated for both flying boat and landplane operations up to crosswinds whose components 90° to the take-off path is 13 kts, with no abnormal handling characteristics being encountered
b. Winds at various angles and velocities, which are the equivalent to a 90° wind at 13 kts, are listed below. Any wind above the velocity shown, for the angle, is outside the limit of safe operation.
c. The maximum gust velocity and most unfavourable direction shall be used to compute the crosswind component.
d. The maximum wind velocity under which it shall be permissible to take-off or land the aircraft shall be limited to a steady wind not in excess of 52 kts.
e. Wind Equivalent to 90° at 13 kts for various angles

| **WIND DIRECTION**<br><br>**ANGLE OFF RUNWAY HEADING** | **MAXIMUM VELOCITY**<br><br>**KTS** |
|---|---|
| 10° | 52 |
| 15 | 50.5 |
| 20 | 38 |
| 25 | 30.5 |
| 30 | 26 |
| 35 | 20 |
| 40 | 18 |
| 45 | 17.5 |
| 50 | 15.5 |
| 55 | 15 |
| 60 | 15 |
| 65 | 14 |
| 70 | 14 |
| 75 | 13 |
| 80 | 13 |
| 85 | 13 |
| 90 | 13 |

Fig 44

## WEIGHT AND BALANCE

### 3.2 COMPARTMENT DATA

The PBY-5A is partitioned into the following major compartments

Nose /Anchor Compartment
- a) Pilots Cockpit Compartment
- b) Passenger Compartment
- c) Water Tank Compartment
- d) Passenger / Cargo / APU Compartment
- e) Blister Cargo Compartment
- f) Light Stowage Compartment

Note: The Blisters are used as passenger viewing area and a limited cargo loading door.

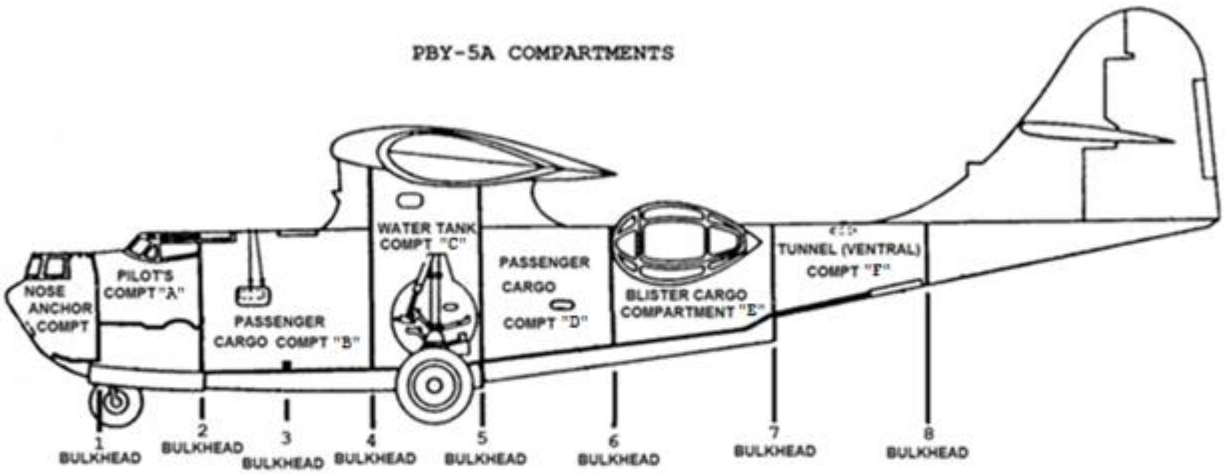



Fig 45

## EMERGENCY EXITS

Compartment "A" Pilots Compartment has two overhead (of the pilots) aft sliding windows to be used in the event of an emergency.

Compartment "B" has two Emergency Exits

- a) The main port side entrance door and
- b) The upper Navigators hatch

## WEIGHT AND BALANCE

### 3.3 STATION LIMITS

| COMPARTMENT | STATION No's<br>From To | STATION LIMITS<br>IN. AFT OF H.R.L. | CENTROID IN. |
|---|---|---|---|
| BOW | 0 1 | Sta. 0 – 58.75 in. | 29.37 |
| A – PILOT | 1 2 | 58.75 – 122.75 in. | (Pilots-108) |
| B –FORWARD | 2 4 | 122.75 – 228.75 in. | 175.75 |
| C- ENGINEER'S | 4 5 | 228.75 – 302.00 in. | 265.37 |
| D – MAIN | 5 6 | 302.00 – 385.75 in. | 343.87 |
| E – AFT | 6 7 | 385.75 – 487.50 in. | 436.62 |
| F - TUNNEL | 7 8 | 487.50 – 563.50 in. | 523.50 |

Fig 46

### 3.4 COMPARTMENT DIMENSIONS

a) Forward Cargo Compartment – (See NOTE 1)

(1) Length .... 101 in.
(2) Average Width .... 108 in.
(3) Height .... 62 in. at enter cabin
(4) Total Floor Area .... 31 sq.ft. each side, approx.
(5) Total Capacity .... 240 cubic feet approx.

b) Main Cargo Compartment – (See NOTE 1)

(1) Length .... 79 in.
(2) Average Width .... 119 in. at Sta. 5, 105 in at Sta.6
(3) Height .... 67 in. at enter cabin
(4) Total Floor Area .... 24.7 sq.ft. each side, approx.
(5) Total Capacity .... 270 cubic feet approx.

c) Aft Compartment – See Appendix

Note: Refer to Appendix of this chapter for information regarding available floor area, tie down facilities, seating arrangements and hatch dimensions, as applicable to individual aircraft.

## WEIGHT AND BALANCE

### 3.5 AIRCRAFT BALANCE

a. **General**

(1) It is the responsibility of the pilot in command to ensure that the load carried is so distributed and secured that the aircraft is safe for flight, and that the aircraft will remain within the allowable center of gravity limits during all phases of flight.

(2) When planning the distribution of the load, consideration shall be given to:

(a) The effect on the balance of the aircraft caused by the retraction and / or extension of the landing gear; and
(b) The effect on the balance of the aircraft caused by the weight of fuel consumed, or estimated to be consumed, enroute.

# PBY-5A PERFORMANCE INFORMATION

## 3.6 Tables

a. Cross Wind Component
b. Wind Component Parallel To Runway

## 3.7 Graphs

a. Required Runway Length for Take-Off LAND
b. Required Runway Length for Take-Off WATER
c. Two Engine Enroute Climb
d. Single Engine Enroute Climb
e. Maximum Terrain Height – Single Engine –
f. Required Runway Length Landing – Land and Flying Boat
g. Airspeed System Position Error Calibration
h. Stalling Speeds – Zero Thrust, Landing Gear Down
i. Accelerated Stop Distance – Land Plane
j. Accelerated Stop Distance – Flying Boat
k. Available Take-Off Climb
l. Available Approach Climb
m. Available Landing Climb – Land Plane
n. Available Landing Climb – Flying Boat

## PBY-5A PERFORMANCE INFORMATION

CROSSWIND COMPONENT TABLE

The following table may be used to find the resultant crosswind component for various angles and wind speeds.

| WIND SPEED | ANGLE BETWEEN WIND DIRECTION AND RUNWAY HEADING 10° | 20° | 30° | 40° | 50° | 60° | 70° | 80° | 90° |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 1 | 2 | 2 | 3 | 4 | 4 | 4 | 5 | 5 |
| 10 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 9 | 10 |
| 15 | 3 | 5 | 7 | 9 | 11 | 13 | 14 | 14 | 15 |
| 20 | 3 | 7 | 10 | 13 | 15 | 17 | 18 | 19 | 20 |
| 25 | 4 | 8 | 12 | 16 | 19 | 22 | 23 | 24 | 25 |
| 30 | 5 | 10 | 15 | 19 | 23 | 26 | 28 | 29 | 30 |
| 35 | 6 | 12 | 17 | 22 | 26 | 30 | 32 | 34 | 35 |
| 40 | 7 | 14 | 20 | 25 | 30 | 35 | 37 | 39 | 40 |
| 45 | 8 | 15 | 22 | 29 | 34 | 39 | 42 | 44 | 45 |
| 50 | 9 | 17 | 25 | 32 | 38 | 43 | 47 | 49 | 50 |
| 55 | 10 | 19 | 27 | 35 | 42 | 48 | 52 | 54 | 55 |
| 60 | 10 | 20 | 30 | 38 | 46 | 52 | 56 | 59 | 60 |
| MPH or KTS | CROSSWIND COMPONENT IN KNOTS OR MPH | | | | | | | | |

Fig 47

WIND COMPONENTS PARALLEL TO RUNWAY

The following table may be used to find wind components parallel to the direction of take-off or landing for various angles and wind speeds Interpolation may be made without appreciable error.

| WIND SPEED | ANGLE BETWEEN WIND DIRECTION AND RUNWAY HEADING 10° | 20° | 30° | 40° | 50° | 60° | 70° | 80° | 90° |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 10 | 9 | 9 | 8 | 6 | 5 | 3 | 2 | 0 |
| 20 | 20 | 19 | 17 | 15 | 13 | 10 | 7 | 3 | 0 |
| 30 | 30 | 28 | 26 | 23 | 19 | 15 | 10 | 5 | 0 |
| 40 | 39 | 38 | 35 | 31 | 26 | 20 | 14 | 7 | 0 |
| 50 | 49 | 47 | 44 | 39 | 32 | 25 | 17 | 9 | 0 |
| 60 | 59 | 56 | 52 | 46 | 38 | 30 | 20 | 10 | 0 |
| MPH or KTS | PARALLEL COMPONENT IN KNOTS OR MPH | | | | | | | | |

Fig 48

## PBY-5A PERFORMANCE INFORMATION

3.8 **Application** – The calculated landing distance which is applied to the illustration below shall be associated with: -

a. Still air conditions and the landing surface most suitable for such conditions; and
b. The elevation of the Airport
c. Any other landing surface which is suitable for the expected wind conditions and not more that 50% of the reported wind component opposite to the direction of take-off, and not less than 150% of the reported wind component in the direction of take-off
d. The effective length of a landing surface shall be the total length of the landing surface suitable for use at the intended time of landing, less the portion, if any, situated beneath an inclined plane surface clearing all obstructions and having the following characteristics:

   (1) It intersects the landing surface, and , at a slope of 1 to 20, extends beyond the approach end of the landing surface.
   (2) It is symmetrical about a vertical plane containing the centre line of the landing surface
   (3) It extends 1500 feet from the intersection with the landing surface
   (4) It's width is 400 feet at the landing surface, increasing uniformly to a width of 1000 feet

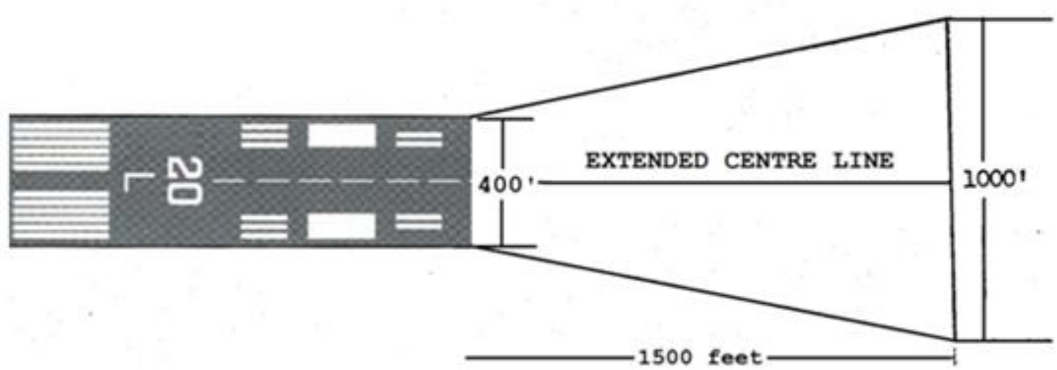



Fig 49

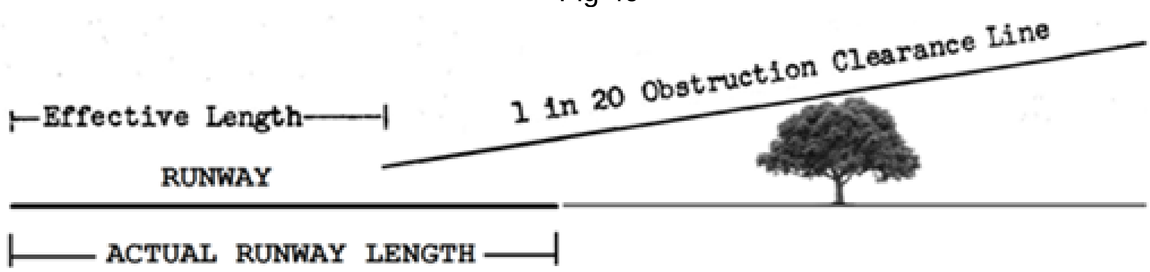



Fig 50

# PBY-5A PERFORMANCE INFORMATION

## 3.9 TAKE-OFF REQUIREMENTS

### a. NIGHT OR IFR

(1) Take-off Run – The take-off run shall not exceed the length of the take-off surface.
(2) Take-Off Distance – The take-off eight shall be such that the take-off distance, all engines operating, does not exceed 75% of the length of the take-off surface
(3) Take-Off Path – The take-off weight shall be such that the aeroplane, with all engine operating, after passing the end of the take-off area can clear all obstacles within 300 feet either side of the intended flight path by 50 feet vertically until the clearance for enroute flight can be complied with.

### b. DAY VFR

(1) Take-off Run – The take-off run shall not exceed the length of the take-off surface.
(2) Take-off Distance –The take-off weight shall be such that:

   (a) The take-off distance does not exceed 75% of the length of the take-off area except that in exceptional circumstances when there is an area within the boundaries of the airport beyond the end of the take-off area that the airport authority has declared suitable to climb to 50 feet the distance required may be increased proportionately; and
   (b) The aeroplane will clear all obstacles in the intended flight path by a safe margin.

## 3.10 PERFORMANCE DATA TO BE APPLIED

a. **Take-Off Distance** – The take-off distance in 3.3.1.2 and 3.3.2.2 shall be the horizontal distance measured from the point where the aeroplane commences its take-off run to a point below the aeroplane when it has attained a height of 50 feet above the level of the take-off area. The speed at a height of 50 feet shall not be less than 1.2 Vsl, where Vsl is the stalling speed in the take-off configuration, with power off.

b. **Application** – In applying 3.3.1.1, 3.3.1.2 and 3.3.2.0, account shall be taken of:

(1) The elevation of the airport;
(2) Not more than 50% of the reported wind component opposite to the take-off, and not less than 150% of the reported wind component in the direction of take-off.

## PBY-5A PERFORMANCE INFORMATION

### 3.11 ENROUTE REQUIREMENTS

a. **NIGHT OR IFR**

(1) All Engines Operating – The take-off weight shall be such that, at all times along the route or planned diversions therefrom, the aeroplane will be capable of a rate of climb of not less than 100 feet per minute at the flight altitude planned, when all engines are operated at maximum continuous power.

(2) One Engine Inoperative – the take-off weight shall be such that, in the event of any one engine becoming inoperative at any point along the route or planned diversions therefrom;

(a) When the aeroplane is in the en route configuration; and
(b) The engine remaining operative is operated within maximum continuous power limitations, the flight can continue to a suitable airport, and a safe landing can be made at that airport.

b. **DAY VFR**

(1) All Engines Operating – The take-off weight shall be such that, at all times along the route or planned diversions therefrom, the aeroplane will be capable of a rate of climb of not less than 100 feet per minute at the flight altitude planned, when all engines are operated at maximum continuous power.

(2) One Engine Inoperative – The take-off weight shall be such that, in the event of an engine becoming inoperative at any point along the route or planned diversions therefrom, it will be possible to affect an emergency landing.

### 3.12 LANDING REQUIREMENTS

a. **NIGHT or IFR and DAY VFR**

(1) Landing Distance – The take-off distance shall be such that, taking into account the fuel and oil consumed, that estimated landing distance will not exceed 70% of the effective length of the landing surface at the airport of intended landing or any alternate.

(2) The landing distance shall be the horizontal distance measured from a point over which the aeroplane passes at the height of 50 feet above the landing surface to the point at which the aeroplane can be brought to a complete stop, or in the

## PBY-5A PERFORMANCE INFORMATION

**NIGHT or IFR and DAY VFR** (continued)

case of a seaplane to a speed approximately 3 kts. The speed at a height of 50 feet shall not be less than 1.2 Vso where Vso is the Stalling Speed in the landing configuration with power off.

### 3.13 PERFORMANCE LIMITATIONS – GRAPHS

The following performance limitations data and graphs, applicable to the Consolidated PBY-5A and 28-5ACF aircraft, shall be used in determining compliance with 9.3 of Information Circular 0/2/52, as detailed in 3.3, 3.4 and 3.5 of this chapter

a. **Graph 3.6.1.1 (a) and 3.6.1.1. (b)**

(1) Required Runway Length for Take-Off – Landplane

(2) Required Runway Length for Take-Off –Flying Boat

Note: The above graph shall be used to determine compliance with the provisions of 3.4.1.2. and 3.4.2.2.

b. **Graph 3.6.1.2(a)**

(1) Two Engine En-route Climb

Note: The above graph shall be used to determine compliance with the provisions of 3.4.1.1. and 3.4.2.1.

c. **Graphs 3.6.1.3(a) and 3.6.1.3 (b)**

(1) Single Engine En-route Climb

(2) Maximum Terrain Height – Single Engine

Note: The above graph shall be used to determine compliance with the provisions of 3.4.1.2. and 3.4.2.2.

d. **Graph 3.6.1.4 (a)**

(3) Required Runway Length for Landing – Landplane and Flying Boat

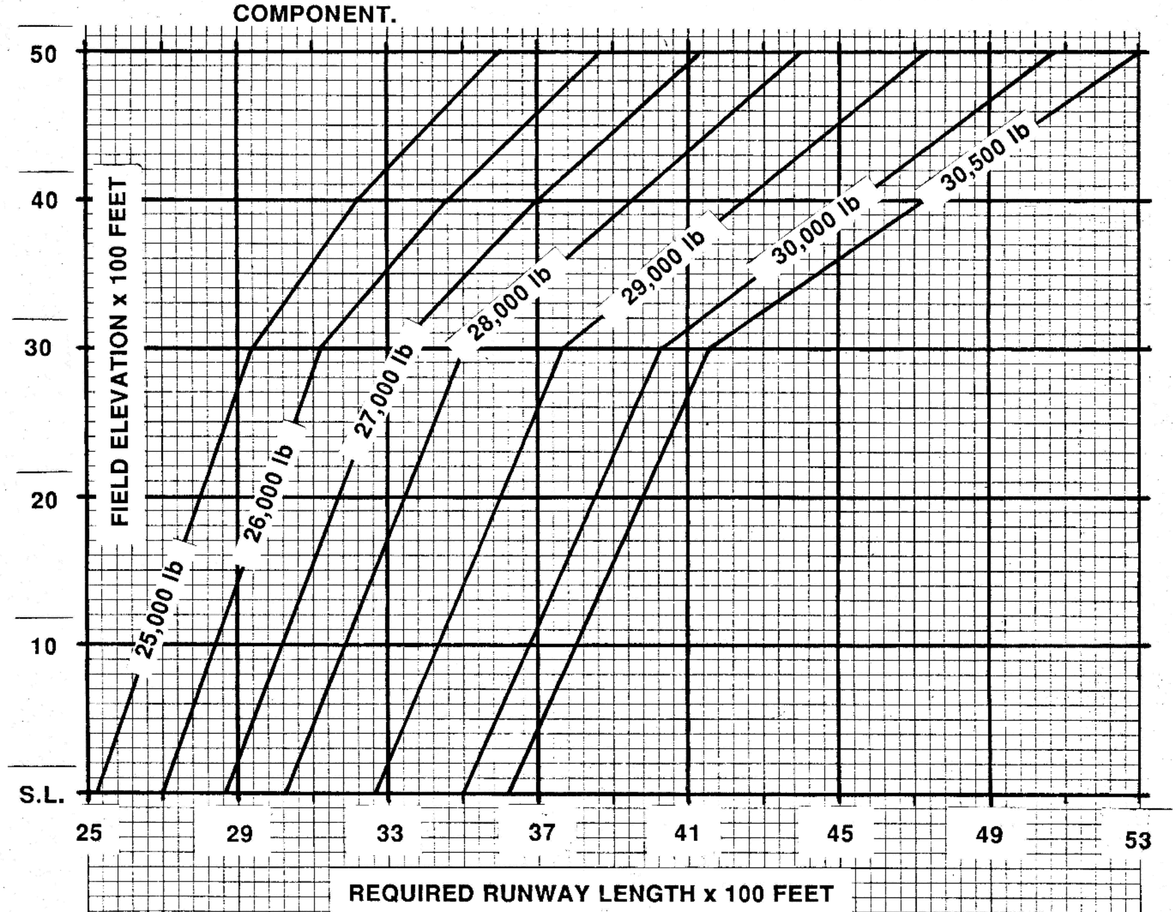
Note: The above graph shows the runway length required to land and stop within 70% of the length of the landing area with the aircraft in the landing configuration, power off, and speed at V50 at 1.3 Vsl. Ref: 3.5.1.1 and 3.5.1.2.

**PBY-5A and 28-5ACF REQUIRED RUNWAY LENGTH FOR TAKE-OFF - LANDPLANE 3:6:1:1(a)**

**REQUIREMENTS: - TO CLIMB TO A FIFTY FOOT HEIGHT WITHIN 75% OF LENGTH OF TAKE-OFF AREA**

**CONDITIONS:- TAKE-OFF POWER BOTH ENGINES**
**LANDING GEAR EXTENDED**
**GROUND SPEED AT TAKE-OFF 87 KTS TIAS**

**NOTE: - RUNWAY LENGTHS MAY BE REDUCED BY 25 FEET FOR EACH 1 KT OF HEAD-WIND COMPONENT. INCREASE BY 75 FEET FOR EACH 1 KT OF TAILWIND COMPONENT.**

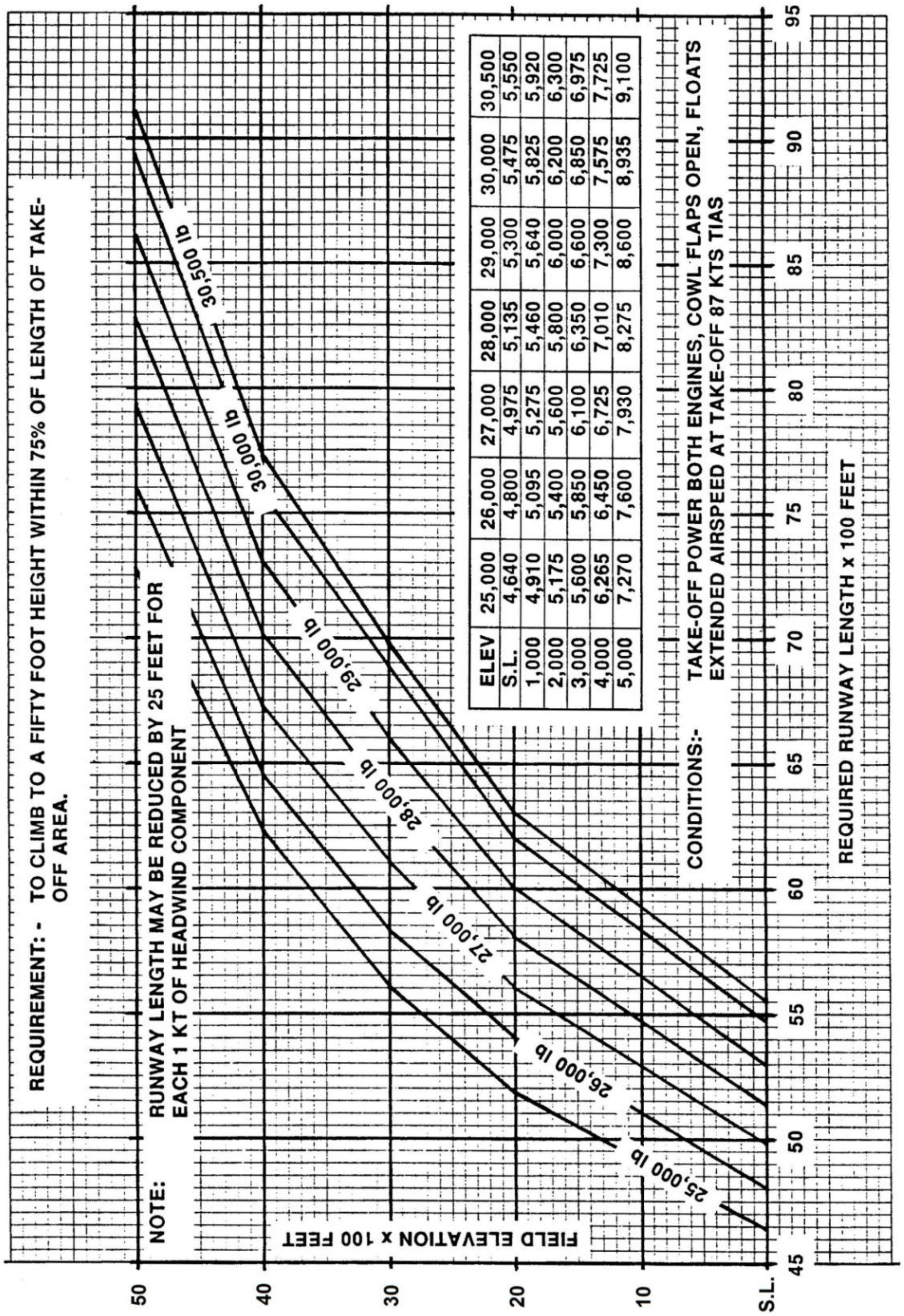



| ELEV | 25,000 | 26,000 | 27,000 | 28,000 | 29,000 | 30,000 | 30,500 |
|---|---|---|---|---|---|---|---|
| S.L. | 2,530 | 2,700 | 2,865 | 3,030 | 3,265 | 3,500 | 3,620 |
| 1,000 | 2,680 | 2,845 | 3,015 | 3,185 | 3,430 | 3,680 | 3,800 |
| 2,000 | 2,820 | 2,995 | 3,160 | 3,350 | 3,600 | 3,855 | 3,980 |
| 3,000 | 2,960 | 3,140 | 3,320 | 3,500 | 3,765 | 4,030 | 4,170 |
| 4,000 | 3,230 | 3,460 | 3,700 | 3,925 | 4,225 | 4,520 | 4,530 |
| 5,000 | 3,600 | 3,865 | 4,135 | 4,400 | 4,730 | 5,065 | 5,230 |

Fig 51

PBY-5A and 28-5ACF

**REQUIRED RUNWAY LENGTH FOR TAKE-OFF - FLYING BOAT** 3:6:1:1(b)




| ELEV | 25,000 | 26,000 | 27,000 | 28,000 | 29,000 | 30,000 | 30,500 |
|---|---|---|---|---|---|---|---|
| S.L. | 4,640 | 4,800 | 4,975 | 5,135 | 5,300 | 5,475 | 5,550 |
| 1,000 | 4,910 | 5,095 | 5,275 | 5,460 | 5,640 | 5,825 | 5,920 |
| 2,000 | 5,175 | 5,400 | 5,600 | 5,800 | 6,000 | 6,200 | 6,300 |
| 3,000 | 5,600 | 5,850 | 6,100 | 6,350 | 6,600 | 6,850 | 6,975 |
| 4,000 | 6,265 | 6,450 | 6,725 | 7,010 | 7,300 | 7,575 | 7,725 |
| 5,000 | 7,270 | 7,600 | 7,930 | 8,275 | 8,600 | 8,935 | 9,100 |

Fig 52

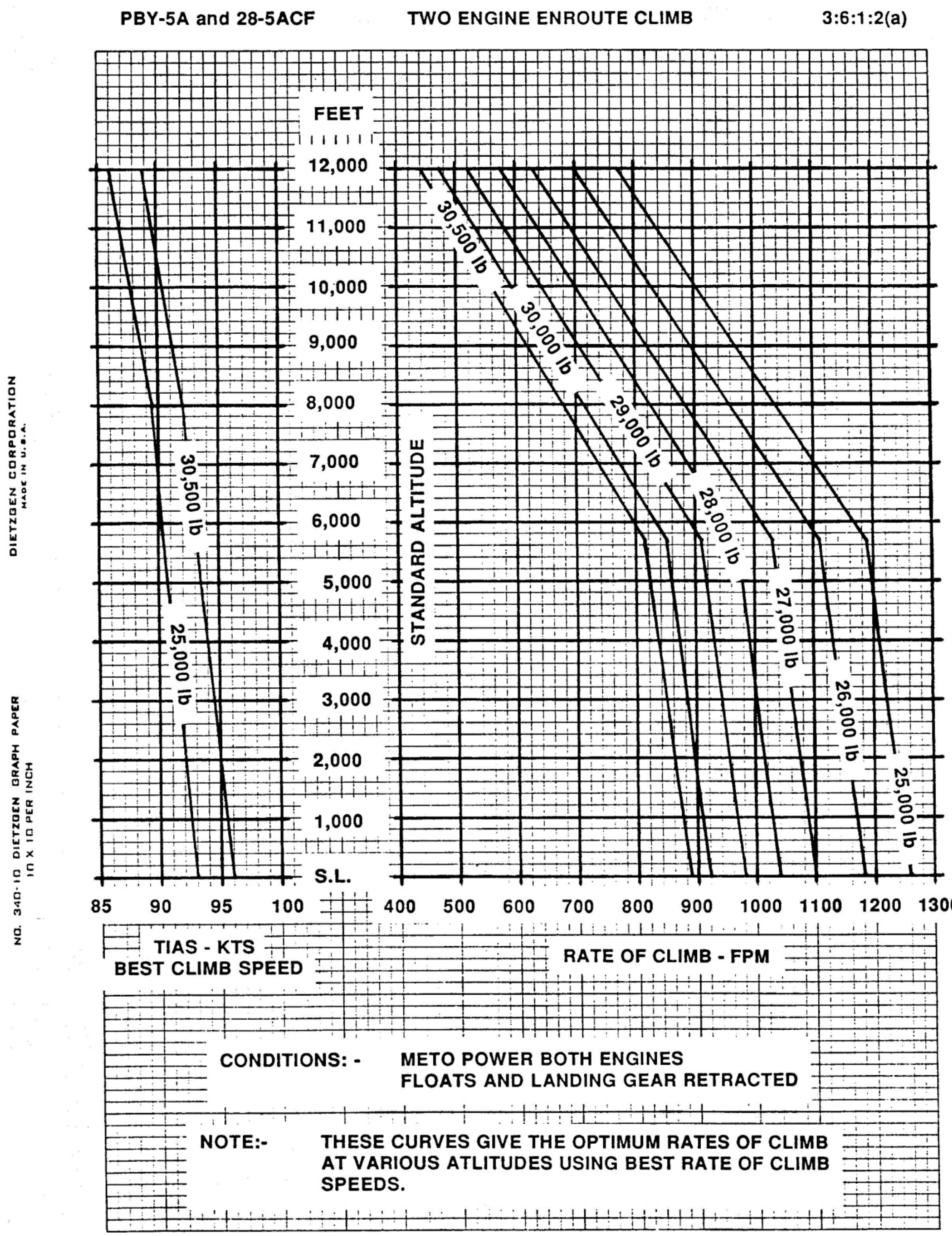
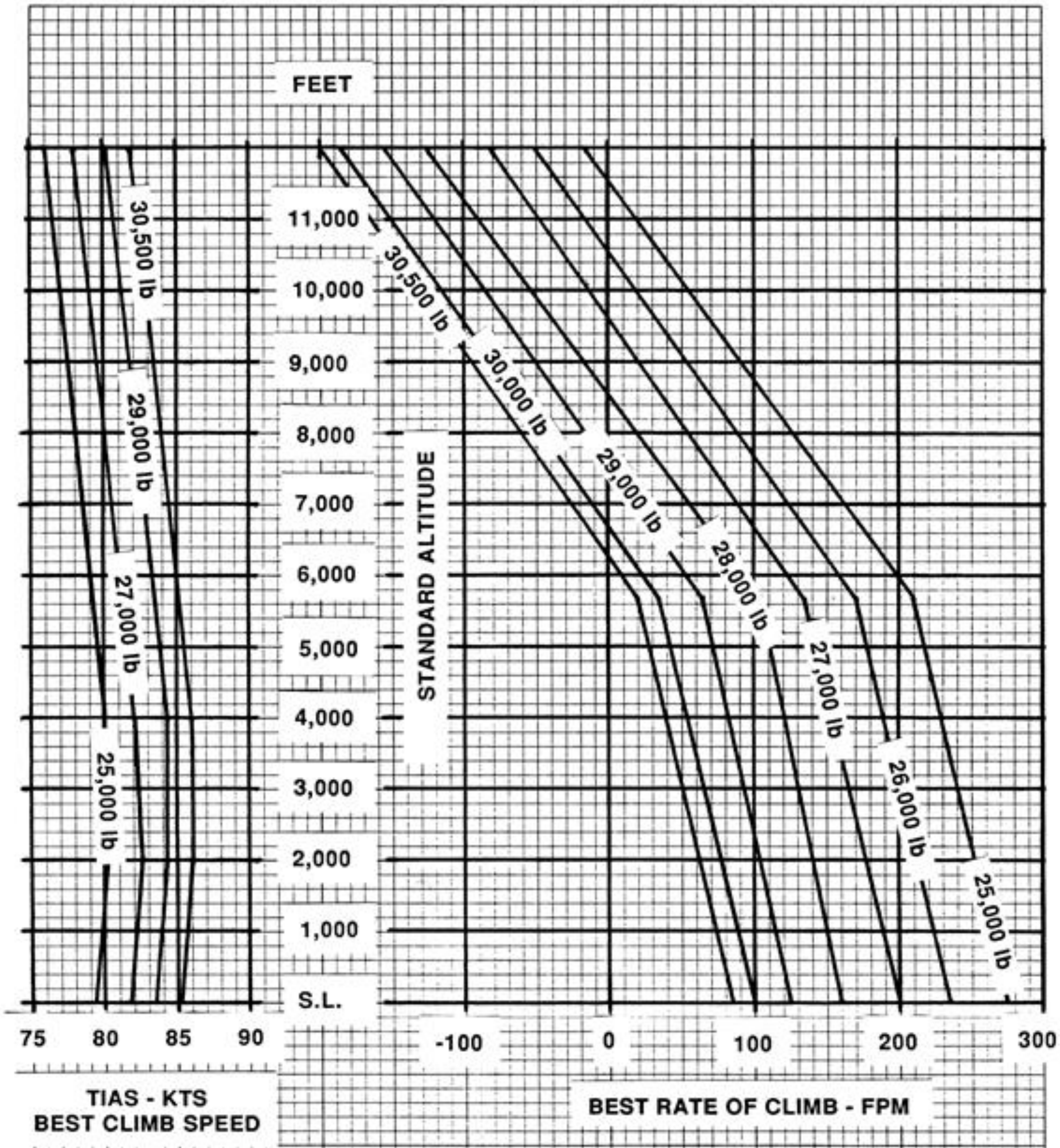

PBY-5A and 28-5ACF
TWO ENGINE ENROUTE CLIMB
3:6:1:2(a)
FEET
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
S.L.
STANDARD ALTITUDE
30,500 lb
25,000 lb
30,500 lb
30,000 lb
29,000 lb
28,000 lb
27,000 lb
26,000 lb
25,000 lb
85
90
95
100
400
500
600
700
800
900
1000
1100
1200
1300
TIAS - KTS
BEST CLIMB SPEED
RATE OF CLIMB - FPM
CONDITIONS: - METO POWER BOTH ENGINES
FLOATS AND LANDING GEAR RETRACTED
NOTE:- THESE CURVES GIVE THE OPTIMUM RATES OF CLIMB AT VARIOUS ATLITUDES USING BEST RATE OF CLIMB SPEEDS.
DIETZGEN CORPORATION
MADE IN U.S.A.
NO. 340-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

Fig 53

PBY-5A and 28-5ACF SINGLE-ENGINE ENROUTE CLIMB 3:6:1:3 (a)




CONDITIONS:- ONE ENGINE INOPERATIVE, METO POWER OTHER INOPERATIVE PROPELLER FEATHERED FLOATS AND LANDING GEAR RETRACTED

NOTE: THESE CURVES GIVE THE OPTIMUM RATES OF CLIMB AT VARIOUS ALTITUDES USING BEST RATE OF CLIMB SPEEDS.

Fig 54

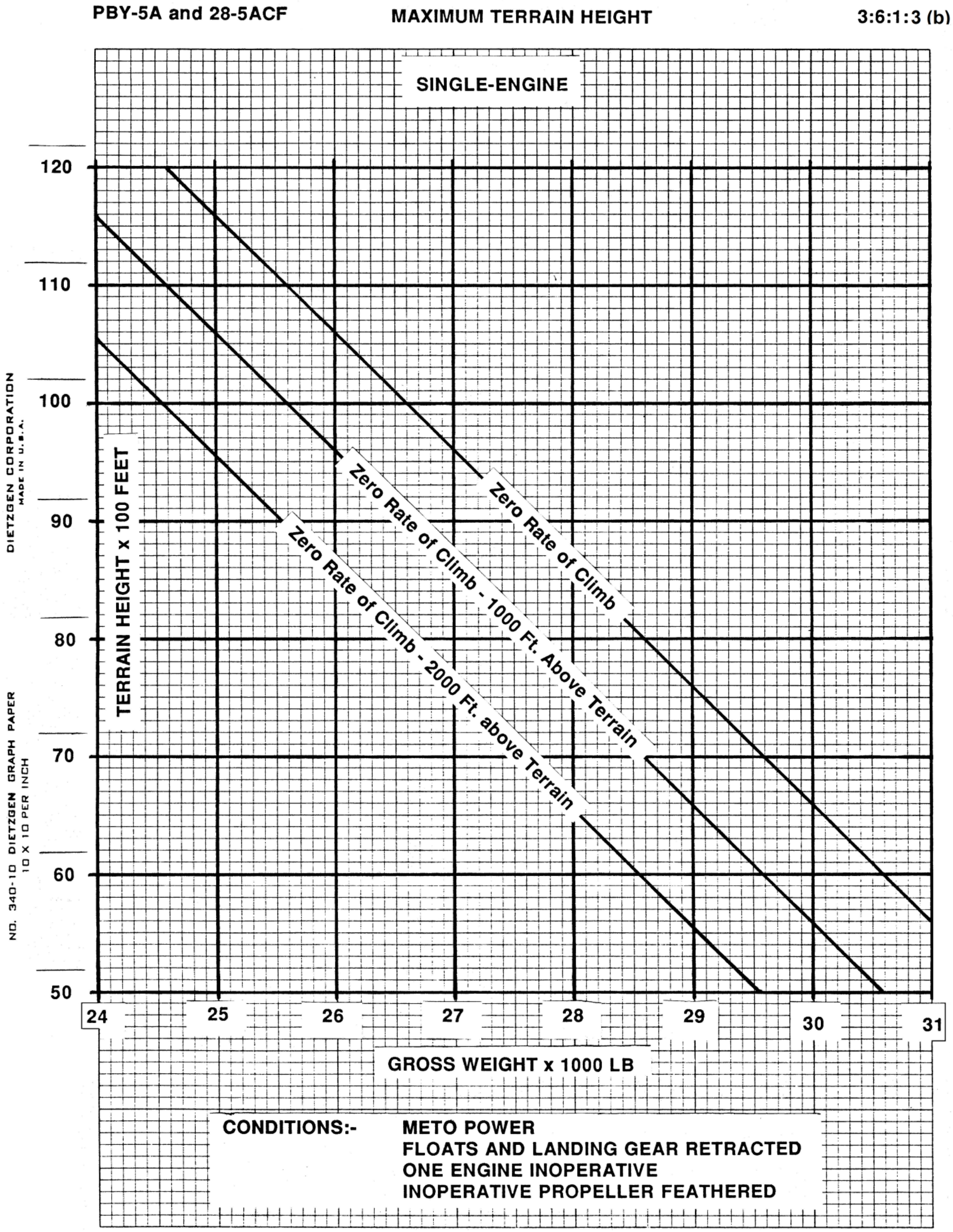

PBY-5A and 28-5ACF
MAXIMUM TERRAIN HEIGHT
3:6:1:3 (b)
SINGLE-ENGINE
TERRAIN HEIGHT x 100 FEET
120
110
100
90
80
70
60
50
Zero Rate of Climb
Zero Rate of Climb - 1000 Ft. Above Terrain
Zero Rate of Climb - 2000 Ft. above Terrain
24
25
26
27
28
29
30
31
GROSS WEIGHT x 1000 LB
CONDITIONS:- METO POWER
FLOATS AND LANDING GEAR RETRACTED
ONE ENGINE INOPERATIVE
INOPERATIVE PROPELLER FEATHERED
DIETZGEN CORPORATION
MADE IN U.S.A.
NO. 340-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

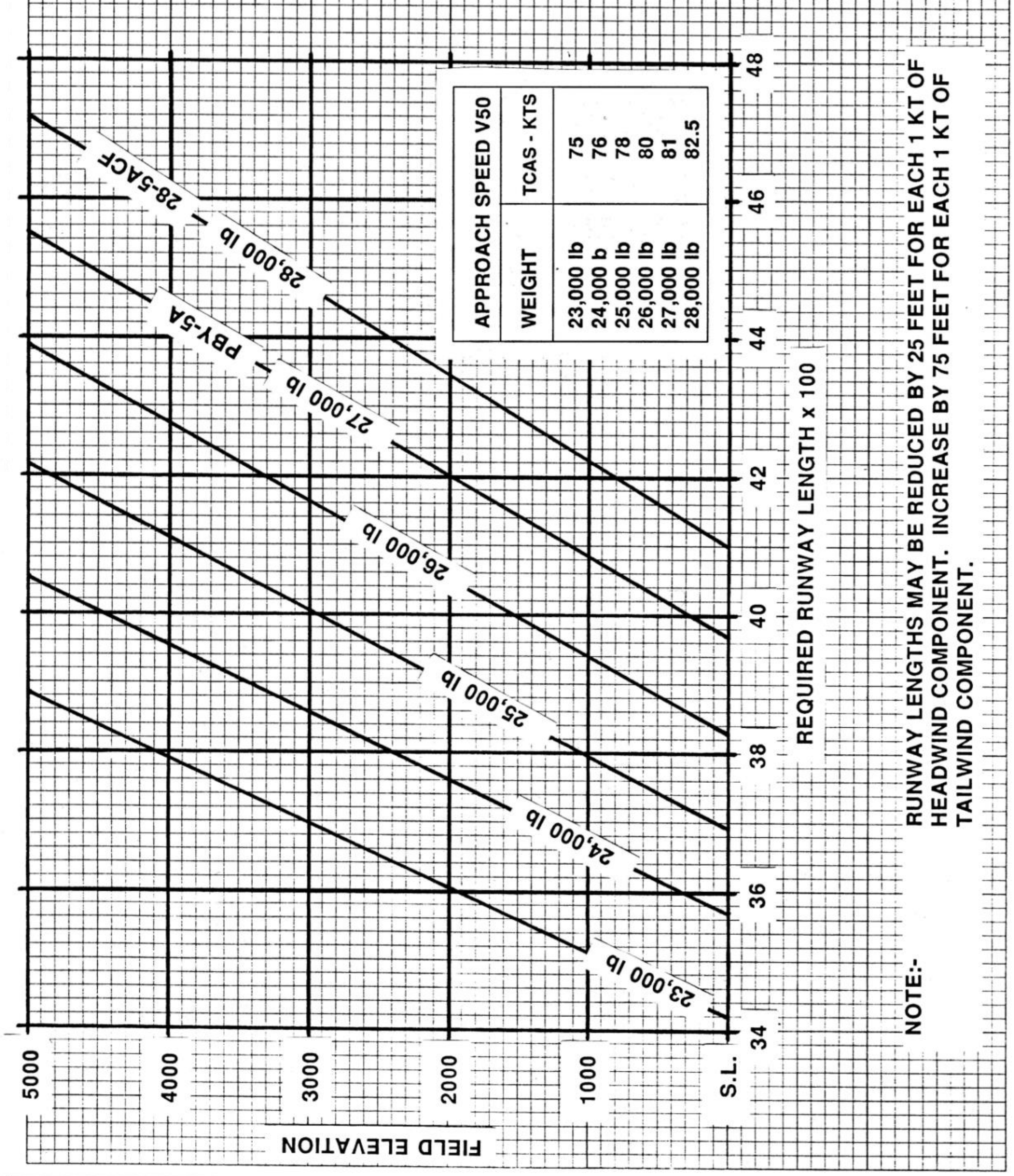
Fig 55

PBY-5A and 28-5ACF — REQUIRED RUNWAY LENGTH FOR LANDING — 3:6:1:4(a)

LANDPLANE AND FLYING BOAT

REQUIREMENT:- TO CLEAR A FIFTY FOOT OBSTACLE AND STOP WITHIN 70% OF LENGTH OF LANDING AREA.

CONDITIONS:- POWER OFF
LANDING GEAR AND/OR FLOATS EXTENDED
APPROACH SPEED AT V50 - 1.3 VSO




| APPROACH SPEED V50 | |
|---|---|
| WEIGHT | TCAS - KTS |
| 23,000 lb | 75 |
| 24,000 b | 76 |
| 25,000 lb | 78 |
| 26,000 lb | 80 |
| 27,000 lb | 81 |
| 28,000 lb | 82.5 |

Fig 56

**PBY-5A and 28-5ACF AIRSPEED SYSTEM Position Error Calibration 3:70:1**

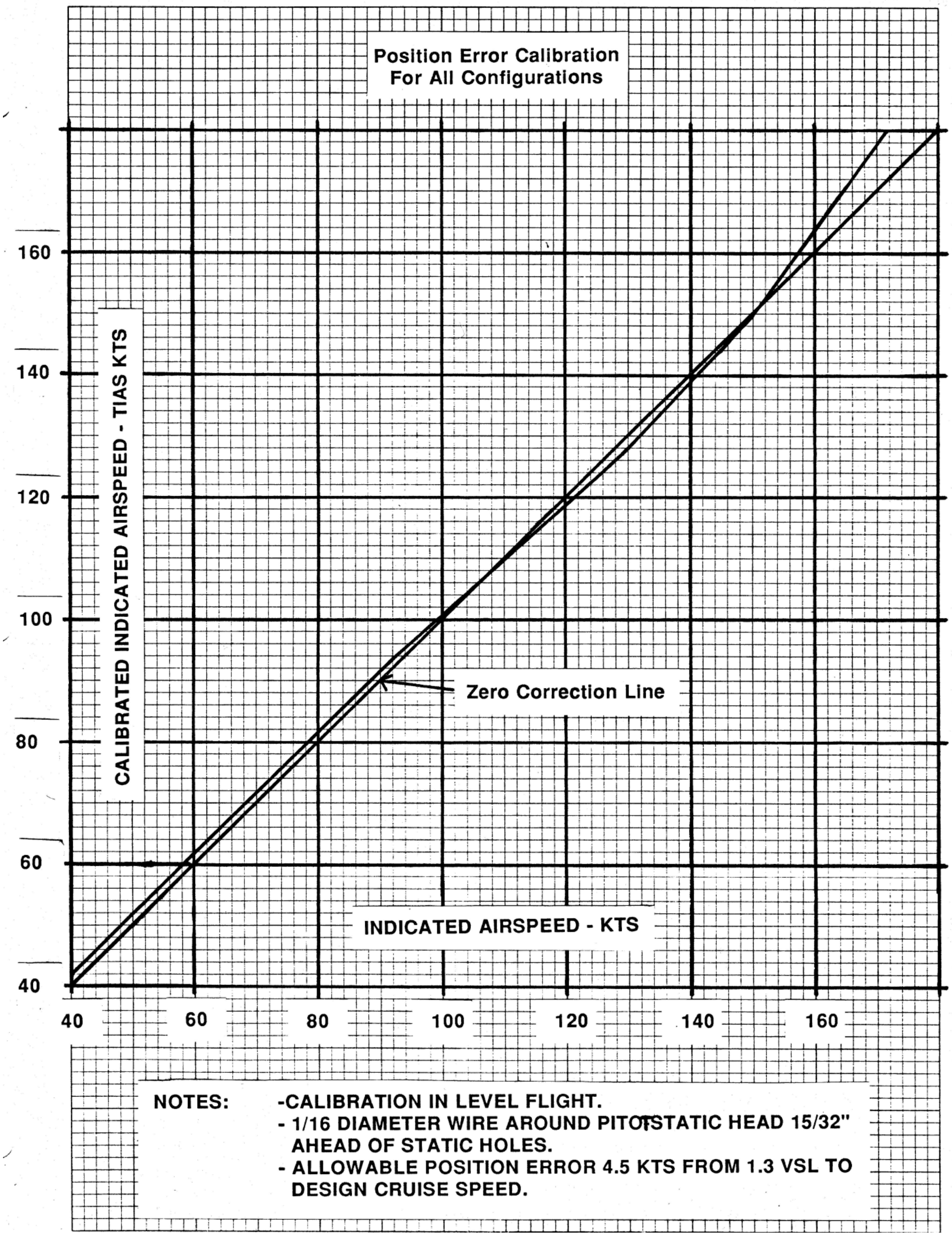



Fig 57

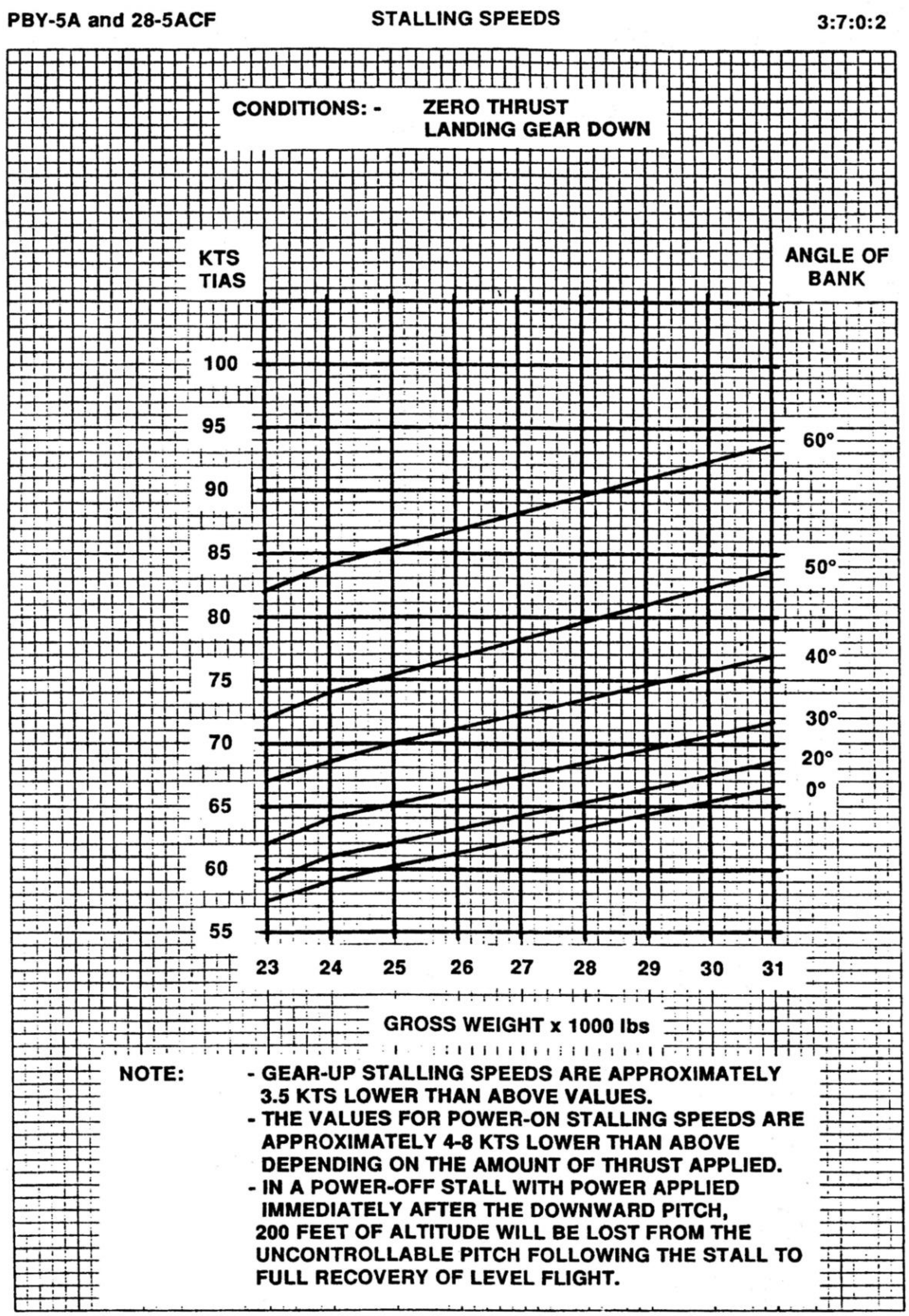
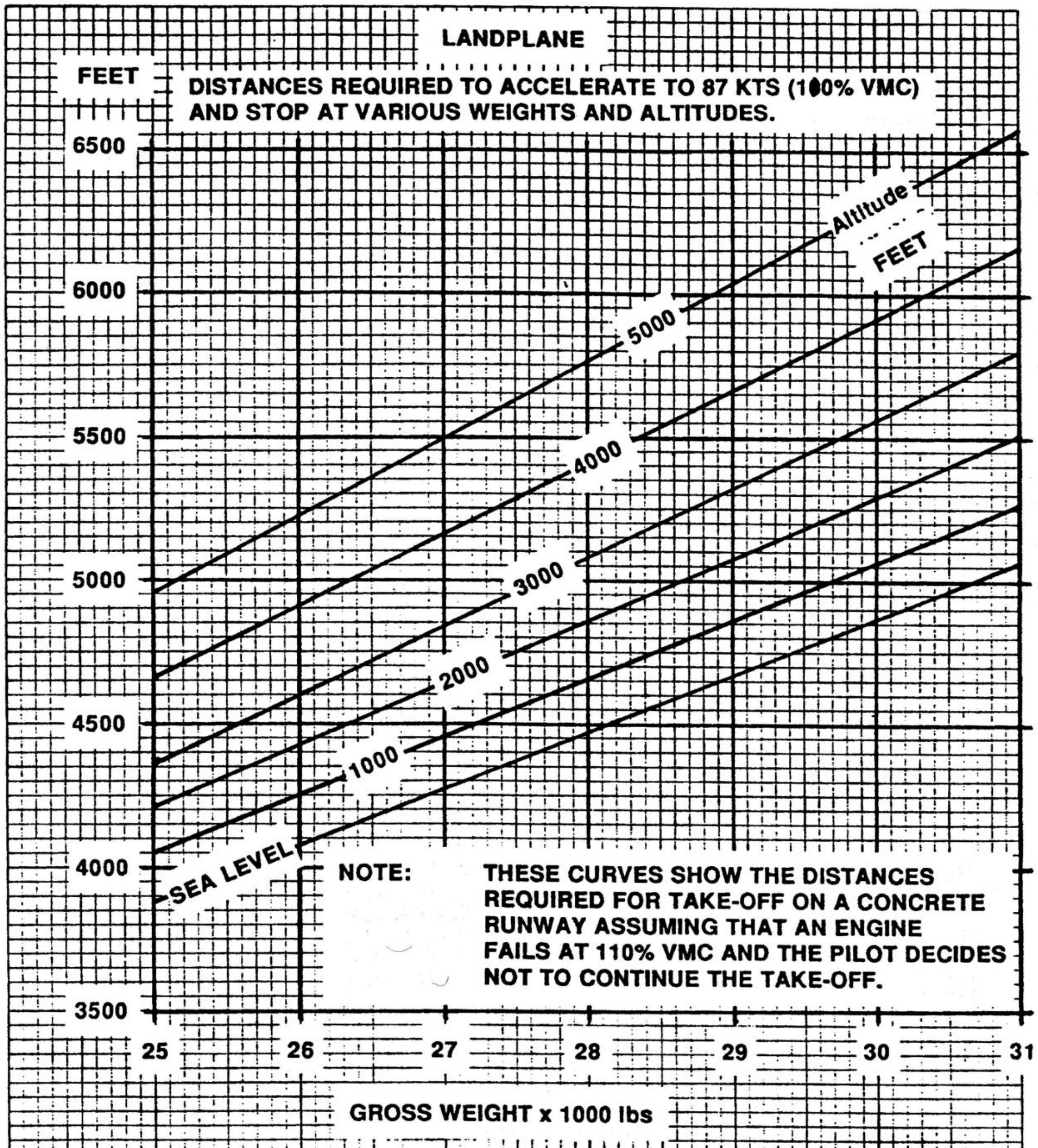

PBY-5A and 28-5ACF
STALLING SPEEDS
3:7:0:2
CONDITIONS: - ZERO THRUST
LANDING GEAR DOWN
KTS
TIAS
ANGLE OF
BANK
100
95
90
85
80
75
70
65
60
55
60°
50°
40°
30°
20°
0°
23
24
25
26
27
28
29
30
31
GROSS WEIGHT x 1000 lbs
NOTE: - GEAR-UP STALLING SPEEDS ARE APPROXIMATELY 3.5 KTS LOWER THAN ABOVE VALUES.
- THE VALUES FOR POWER-ON STALLING SPEEDS ARE APPROXIMATELY 4-8 KTS LOWER THAN ABOVE DEPENDING ON THE AMOUNT OF THRUST APPLIED.
- IN A POWER-OFF STALL WITH POWER APPLIED IMMEDIATELY AFTER THE DOWNWARD PITCH, 200 FEET OF ALTITUDE WILL BE LOST FROM THE UNCONTROLLABLE PITCH FOLLOWING THE STALL TO FULL RECOVERY OF LEVEL FLIGHT.

Fig 58

**PBY-5A and 28-5ACF** **ACCELERATE - STOP DISTANCES** **3:7:0:3**




| ELEV. | 25,000 | 26,000 | 27,000 | 28,000 | 29,000 | 30,000 | 30,500 |
|---|---|---|---|---|---|---|---|
| S.L. | 3,880 | 4,080 | 4,270 | 4,460 | 4,700 | 4,820 | 4,960 |
| 1,000 | 4,050 | 4,250 | 4,460 | 4,700 | 4,860 | 5,070 | 5,170 |
| 2,000 | 4,220 | 4,430 | 4,640 | 4,860 | 5,070 | 5,290 | 5,400 |
| 3,000 | 4,360 | 4,600 | 4,840 | 5,080 | 5,320 | 5,560 | 5,680 |
| 4,000 | 4,660 | 4,915 | 5,160 | 5,410 | 5,660 | 5,910 | 6,040 |
| 5,000 | 4,960 | 5,230 | 5,500 | 5,760 | 6,030 | 6,300 | 6,440 |

Fig 59

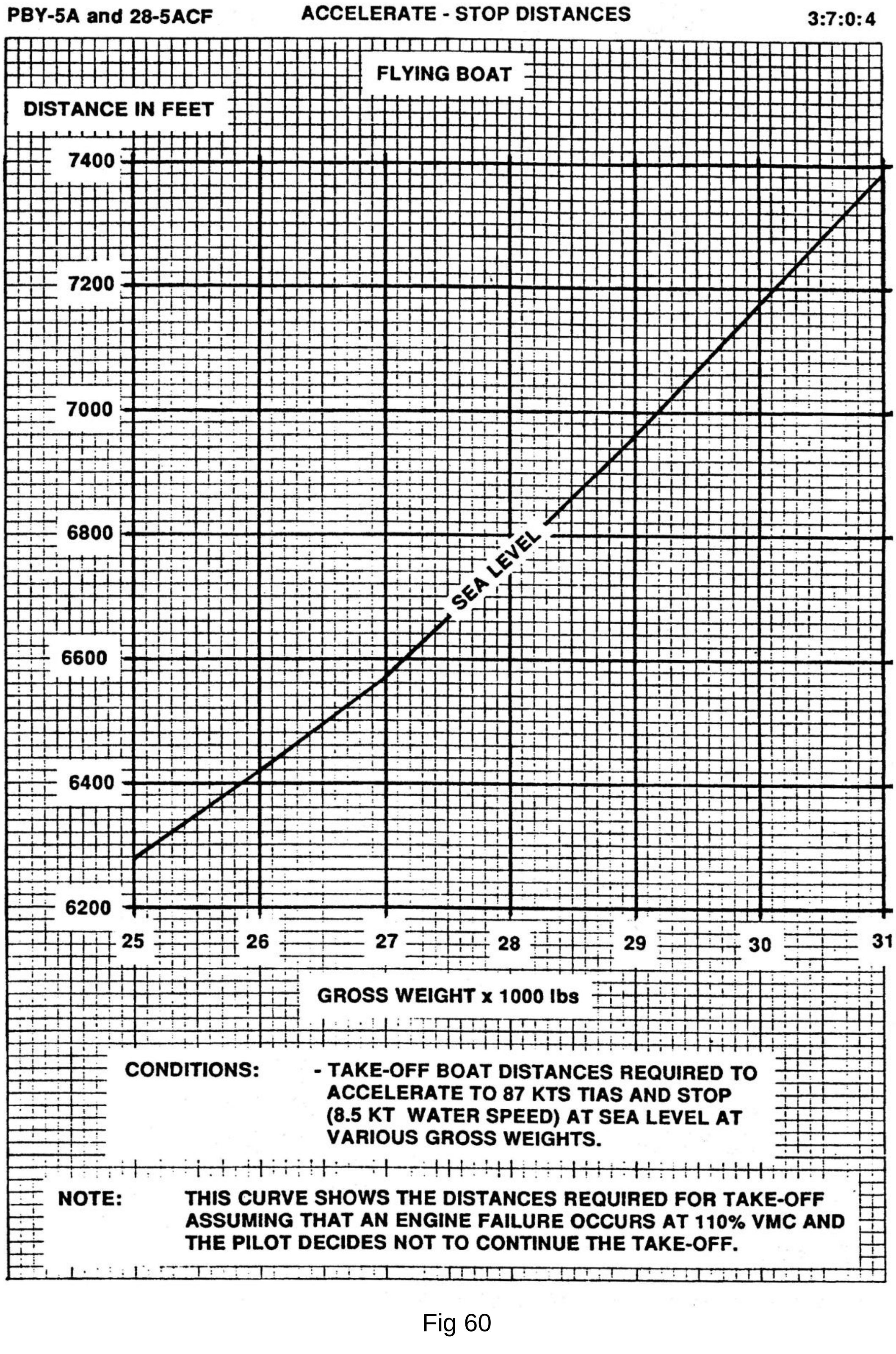

PBY-5A and 28-5ACF
ACCELERATE - STOP DISTANCES
3:7:0:4
FLYING BOAT
DISTANCE IN FEET
7400
7200
7000
6800
6600
6400
6200
SEA LEVEL
25
26
27
28
29
30
31
GROSS WEIGHT x 1000 lbs
CONDITIONS: - TAKE-OFF BOAT DISTANCES REQUIRED TO ACCELERATE TO 87 KTS TIAS AND STOP (8.5 KT WATER SPEED) AT SEA LEVEL AT VARIOUS GROSS WEIGHTS.
NOTE: THIS CURVE SHOWS THE DISTANCES REQUIRED FOR TAKE-OFF ASSUMING THAT AN ENGINE FAILURE OCCURS AT 110% VMC AND THE PILOT DECIDES NOT TO CONTINUE THE TAKE-OFF.

Fig 60

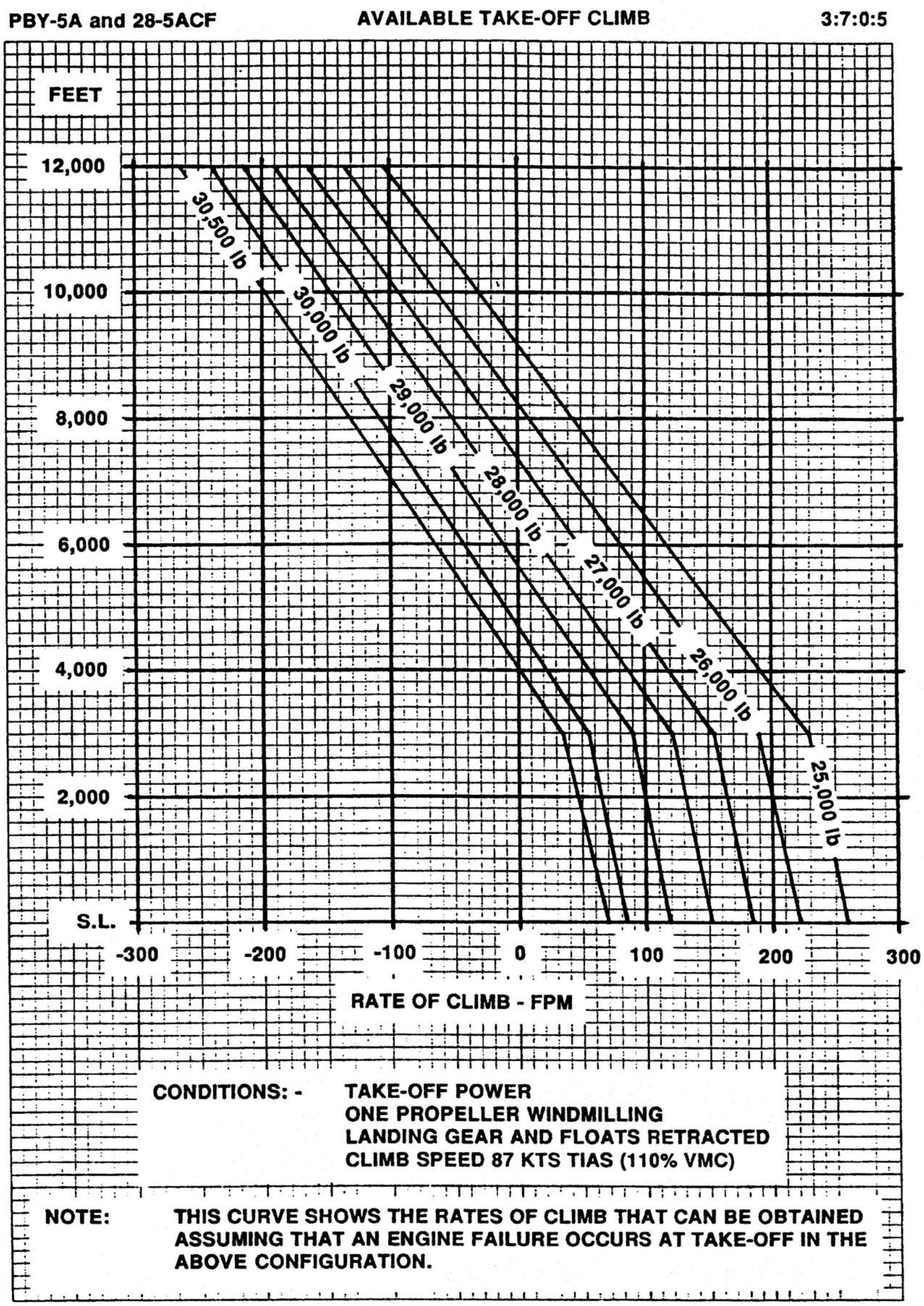

PBY-5A and 28-5ACF
AVAILABLE TAKE-OFF CLIMB
3:7:0:5
FEET
12,000
10,000
8,000
6,000
4,000
2,000
S.L.
30,500 lb
30,000 lb
29,000 lb
28,000 lb
27,000 lb
26,000 lb
25,000 lb
-300
-200
-100
0
100
200
300
RATE OF CLIMB - FPM
CONDITIONS: - TAKE-OFF POWER
ONE PROPELLER WINDMILLING
LANDING GEAR AND FLOATS RETRACTED
CLIMB SPEED 87 KTS TIAS (110% VMC)
NOTE: THIS CURVE SHOWS THE RATES OF CLIMB THAT CAN BE OBTAINED ASSUMING THAT AN ENGINE FAILURE OCCURS AT TAKE-OFF IN THE ABOVE CONFIGURATION.

Fig 61

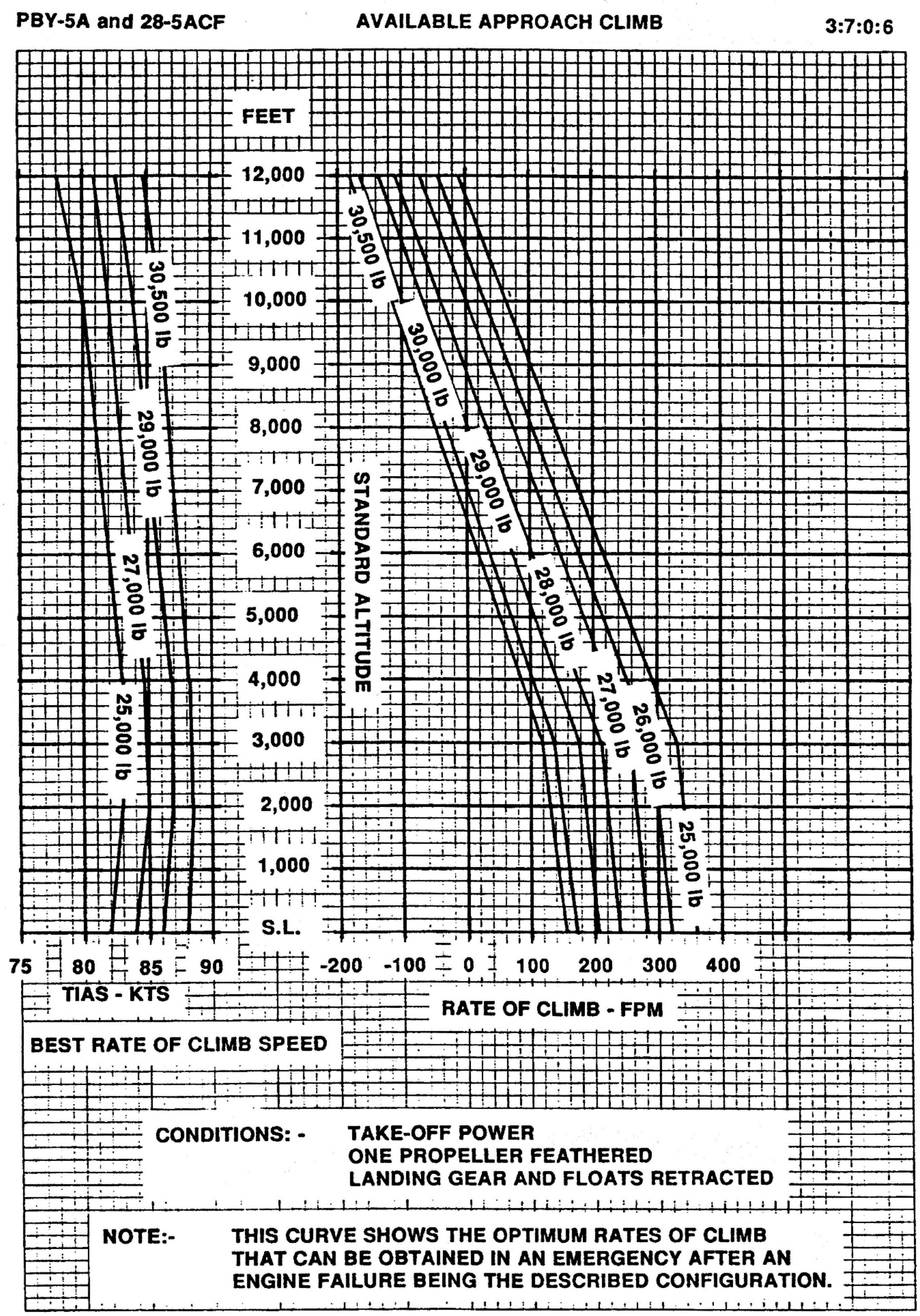

PBY-5A and 28-5ACF
AVAILABLE APPROACH CLIMB
3:7:0:6
FEET
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
S.L.
30,500 lb
29,000 lb
27,000 lb
25,000 lb
30,500 lb
30,000 lb
29,000 lb
28,000 lb
27,000 lb
26,000 lb
25,000 lb
STANDARD ALTITUDE
75
80
85
90
TIAS - KTS
-200
-100
0
100
200
300
400
RATE OF CLIMB - FPM
BEST RATE OF CLIMB SPEED
CONDITIONS: - TAKE-OFF POWER
ONE PROPELLER FEATHERED
LANDING GEAR AND FLOATS RETRACTED
NOTE:- THIS CURVE SHOWS THE OPTIMUM RATES OF CLIMB
THAT CAN BE OBTAINED IN AN EMERGENCY AFTER AN
ENGINE FAILURE BEING THE DESCRIBED CONFIGURATION.

Fig 62

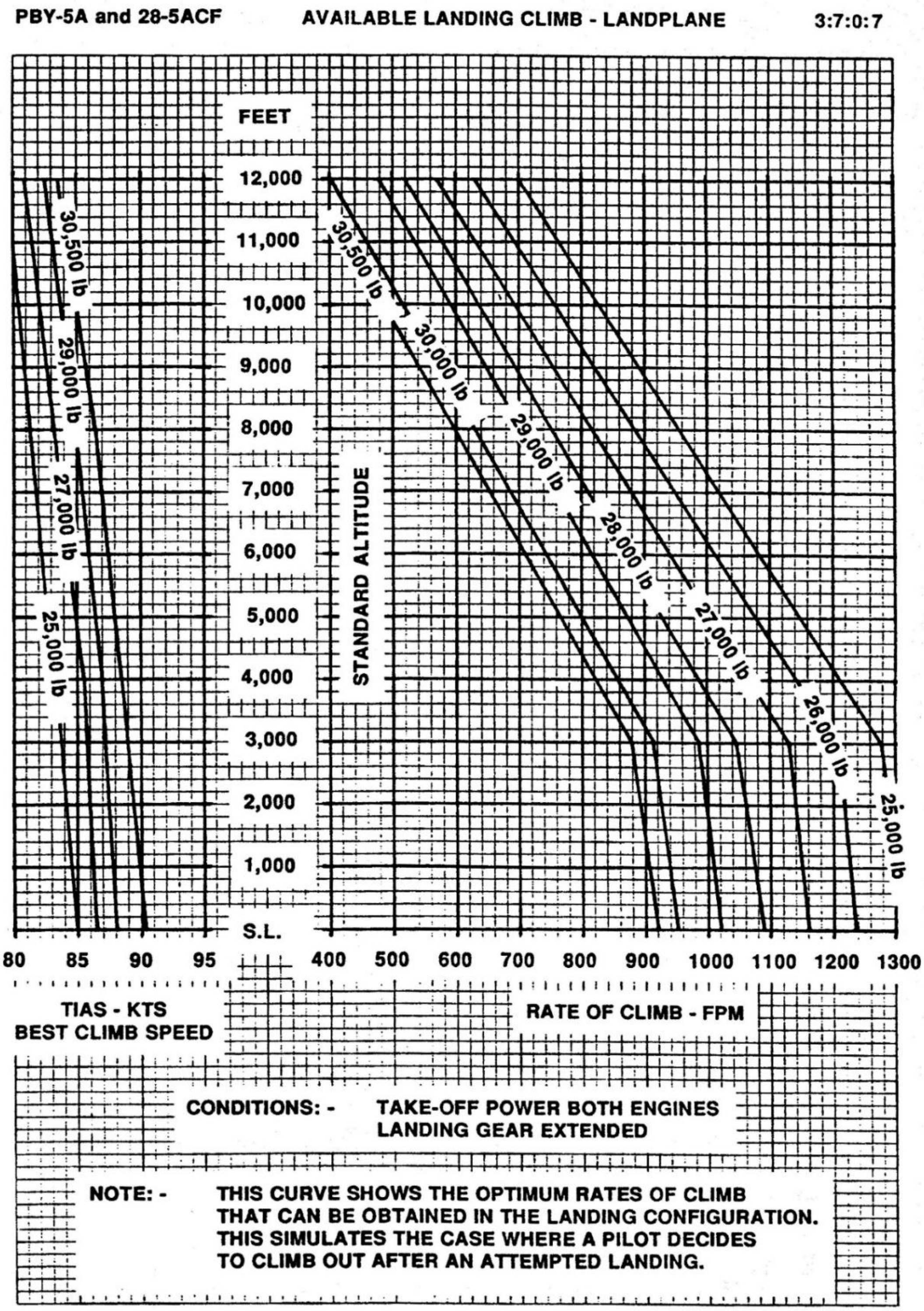

PBY-5A and 28-5ACF
AVAILABLE LANDING CLIMB - LANDPLANE
3:7:0:7
FEET
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
S.L.
STANDARD ALTITUDE
30,500 lb
29,000 lb
27,000 lb
25,000 lb
30,500 lb
30,000 lb
29,000 lb
28,000 lb
27,000 lb
26,000 lb
25,000 lb
80 85 90 95
400 500 600 700 800 900 1000 1100 1200 1300
TIAS - KTS
BEST CLIMB SPEED
RATE OF CLIMB - FPM
CONDITIONS: - TAKE-OFF POWER BOTH ENGINES
LANDING GEAR EXTENDED
NOTE: - THIS CURVE SHOWS THE OPTIMUM RATES OF CLIMB
THAT CAN BE OBTAINED IN THE LANDING CONFIGURATION.
THIS SIMULATES THE CASE WHERE A PILOT DECIDES
TO CLIMB OUT AFTER AN ATTEMPTED LANDING.

Fig 63

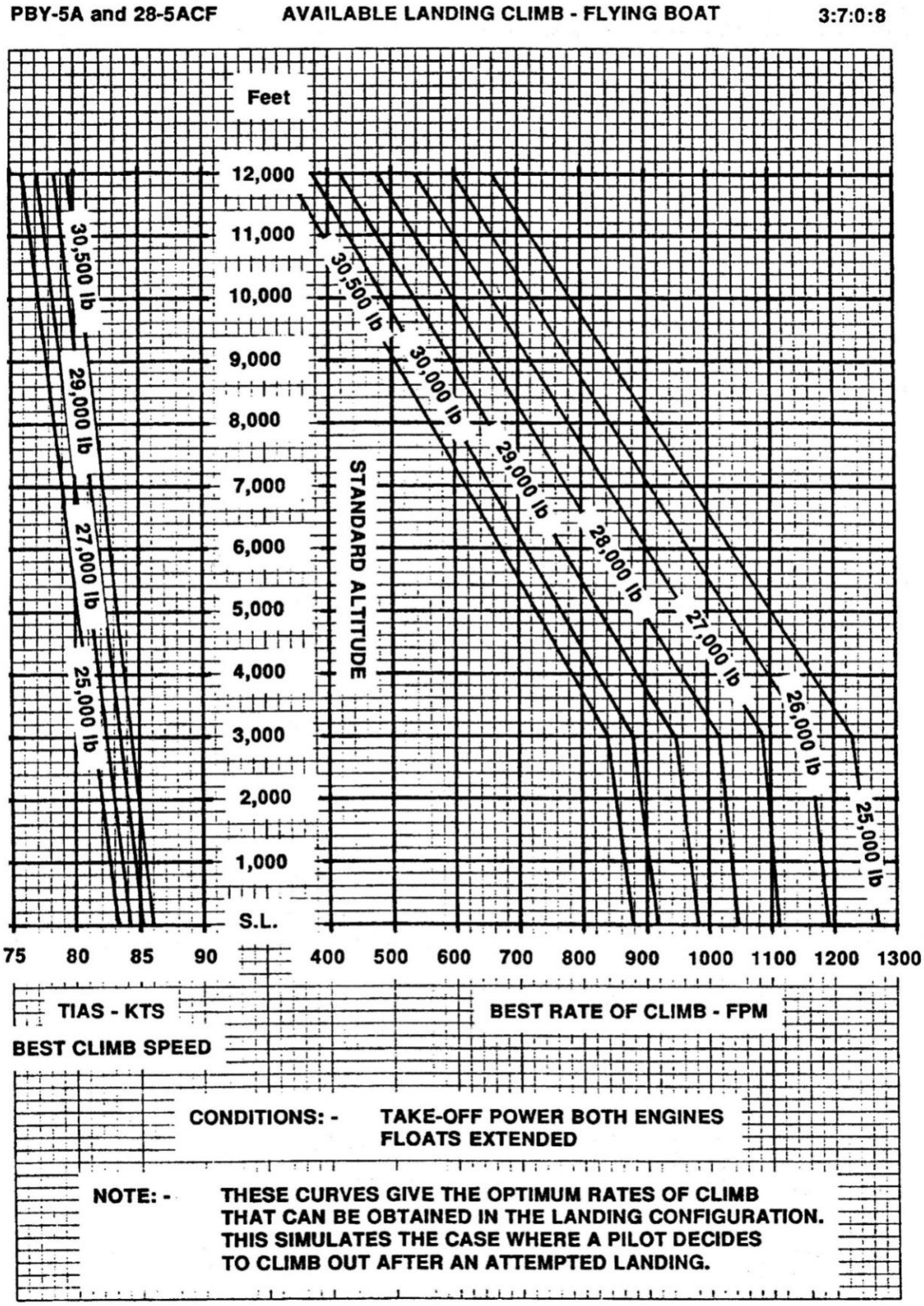

PBY-5A and 28-5ACF
AVAILABLE LANDING CLIMB - FLYING BOAT
3:7:0:8
Feet
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
S.L.
STANDARD ALTITUDE
30,500 lb
29,000 lb
27,000 lb
25,000 lb
30,500 lb
30,000 lb
29,000 lb
28,000 lb
27,000 lb
26,000 lb
25,000 lb
75
80
85
90
400
500
600
700
800
900
1000
1100
1200
1300
TIAS - KTS
BEST CLIMB SPEED
BEST RATE OF CLIMB - FPM
CONDITIONS: - TAKE-OFF POWER BOTH ENGINES
FLOATS EXTENDED
NOTE: - THESE CURVES GIVE THE OPTIMUM RATES OF CLIMB
THAT CAN BE OBTAINED IN THE LANDING CONFIGURATION.
THIS SIMULATES THE CASE WHERE A PILOT DECIDES
TO CLIMB OUT AFTER AN ATTEMPTED LANDING.

Fig 64

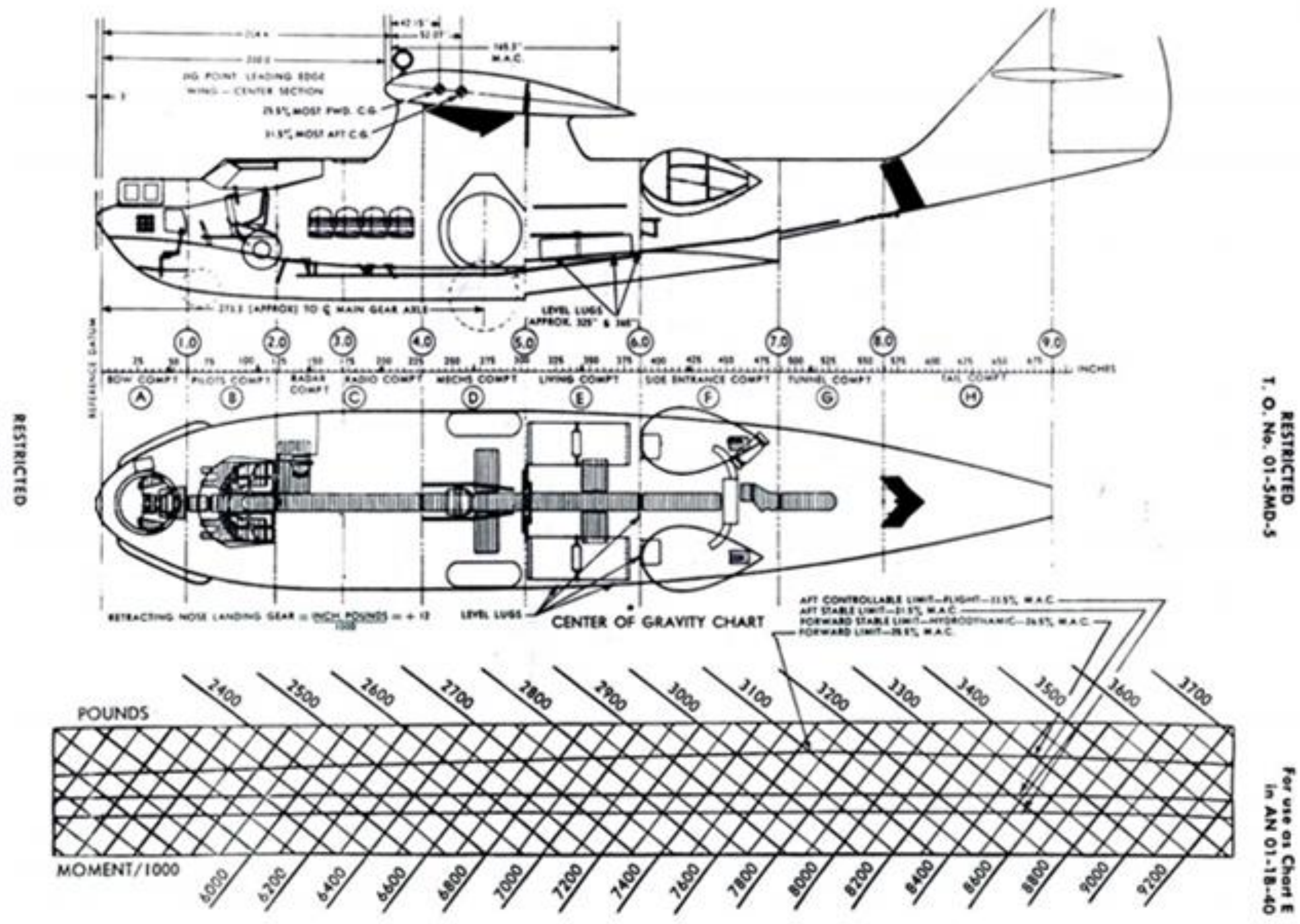

RESTRICTED
T. O. No. 01-5MD-5
CENTER OF GRAVITY CHART
POUNDS
MOMENT/1000
For use as Chart E in AN 01-1B-40

Fig 65

# CHAPTER 4

# WEIGHT LIMITATIONS

## WEIGHT AND BALANCE

### 4.0 Loading Limitations

a. **GENERAL**

1) Refer to the Weight and Balance Report of the aircraft concerned to determine the provisional take-off and landing weights authorized by the D.O.T. for that particular aircraft
2) Refer to chapter of this manual to determine possible restrictions of take-off and landing weights due to performance considerations.

### 4.1 COMPARTMENT WEIGHT PLACARDS

a. Bow compartment, sta. 0 to 1 – “A”
*No baggage to be carried in this compartment*

b. Forward cargo compartment, sta. 2 to 4 – “B”

1) Maximum unit load ....... 83 pounds per square ft.
2) Maximum load - Port side ..... 1870 pounds
3) Maximum load - Starboard side ..... 1870 pounds
4) Maximum total load ..... 3740 pounds

c. **Engineer’s Compartment**, Sta. 4 to 5 – “C”

1) Maximum Unit Load ....... 36 pounds per square ft.
2) Maximum Total Load ...... 936 pounds (Note a)

d. **Main compartment**, Sta. 5 to 6 – “D”

1) Maximum Unit Load ....... 83 pounds per square ft.
2) Maximum Load – Port Side ..... 2050 pounds
3) Maximum Load – Starboard Side ..... 2050 pounds
4) Maximum Total Load ..... 4100 pounds

e. **Aft compartment**, Sta. 6 to 7, - “E”

1) Maximum Unit Load ....... 83 pounds per square ft.
2) Maximum Total Load .....3240 pounds (Note b.)

f. **Tunnel compartment**, Sta. 7 to 8, - “F”

1) No baggage to be carried in this compartment
2) This compartment to be used for stowage of light, miscellaneous items of equipment only.

Note:

a. This limitation assumes the availability of 26 sq. ft. of floor area, adequate flooring and tie-down fittings. No cargo in this compartment if the last two items not provided.

b. This limitation is based on the availability of 39 square feet of floor area. If less than this amount is available, care must be taken not to exceed the maximum unit floor loading limitation of 83 pounds per square foot.

## WEIGHT AND BALANCE

### 4.2 AIRCRAFT BALANCE

#### a. GENERAL

1) It is the responsibility of the pilot in command to ensure that the load carried is so distributed and secured that the aircraft is safe for flight, and that the aircraft will remain within the allowable center of gravity limits during all phases of flight.

2) When planning the distribution of the load, consideration shall be given to:

   (a) The effect on the balance of the aircraft caused by the retraction and / or extension of the landing gear; and
   (b) The effect on the balance of the aircraft caused by the weight of fuel consumed, or estimated to be consumed, en route.

#### b. Center of Gravity Range – With Gear Down

| | | | |
|---|---|---|---|
| 1) | Forward limit – Both Models .......... | | 22.9% MAC or 242.2 inches |
| 2) | Aft Limit | 28-5ACF ............... | 28.2% MAC or 251.0 inches |
| | | PBY-5A ................ | 28.5% MAC or 251.5 inches |

#### c. Miscellaneous Information

1) Mean Aerodynamic Chord ............ 165.3 inches
2) Leading Edge or MAC .................. Station 204.39 inches
3) % MAC Formula ............................ $\%MAC = \dfrac{\text{C.G. Arm}'' - 204.39}{165.3 \times 100}$
4) To find C.G. in inches ................... $\text{C.G.}'' = \dfrac{\text{Total Moment in Inch Lbs}}{\text{Total weight in Lbs}}$
5) Index Formula ............................... $\text{Index} = 70 - \dfrac{\text{Weight } (258.95 - \text{Arm})}{10{,}000}$
6) Effect of Gear Retraction .............. Plus 12.485 inch pounds

## WEIGHT AND BALANCE

d. **Weight and Balance Determination (continued)**

1) Items of standard equipment installed in the aircraft at the time of weighing may be determined by reference to Maintenance form M50, “Aircraft Weighing Record Sheet”.

2) The aircraft Basic Weight, center of gravity arm and moment arm, may be determined by reference to Maintenance Form M51 “Weight and Balance Report”. Two configurations are presented: one as a freighter and one as a Passenger Version with seats installed.

### 4.3 SAMPLE LOADING PROBLEM

a. Complete the left half of the Weight and Balance form inserting data and computing totals. Compute the index for your aircraft using Index Formula 6.???. Enter index at the top of the graph on the right half of the Weight and Balance Form. Starting at the index work from the top to bottom entering the appropriate weights, noting fuel and oil are in Imperial Gallons or kilograms. After entry of the Oil the line descends vertically to show C.of G. for the weight desired. For landing, subtract fuel and oil used, then re-enter graph

**WEIGHT AND BALANCE**

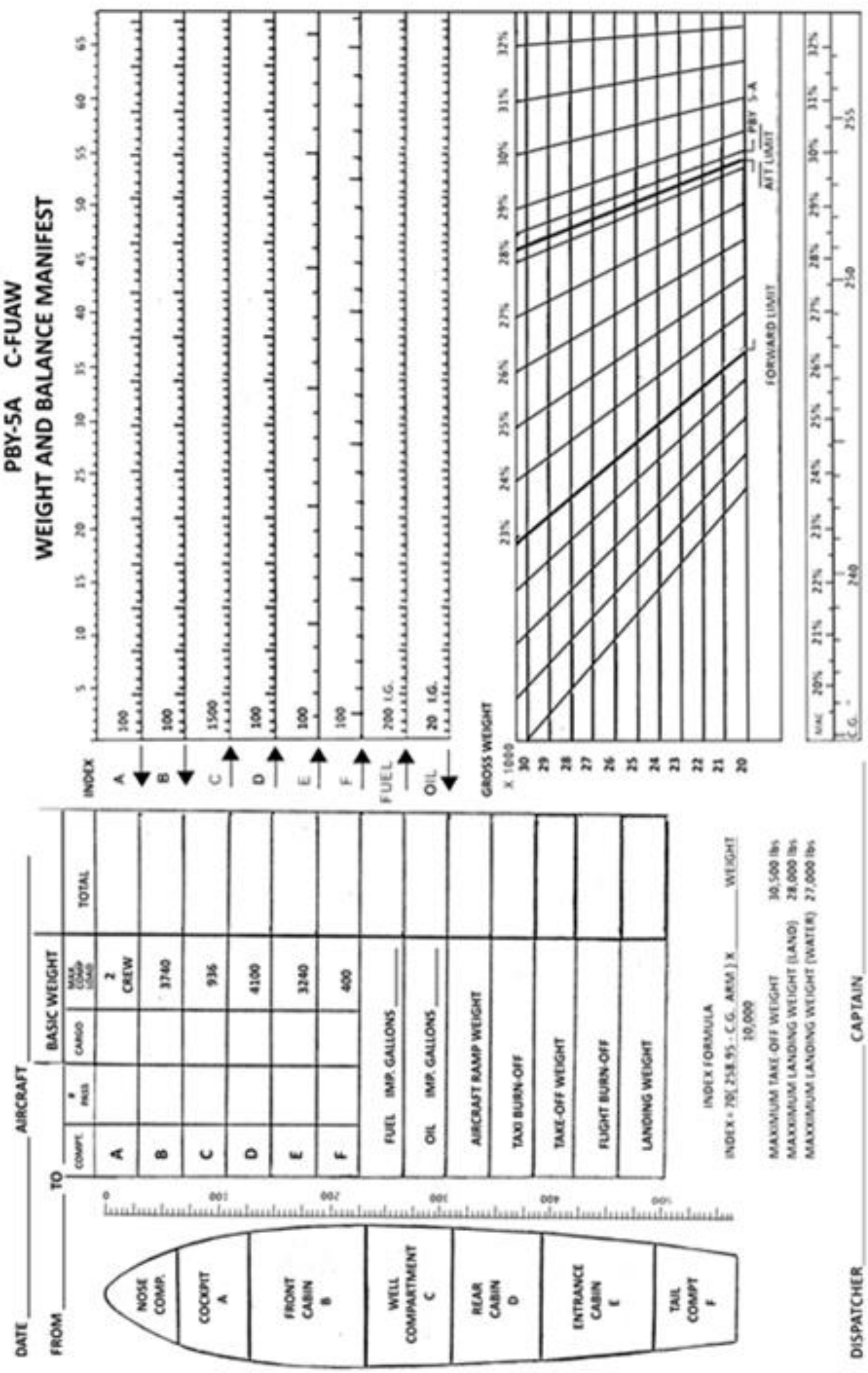
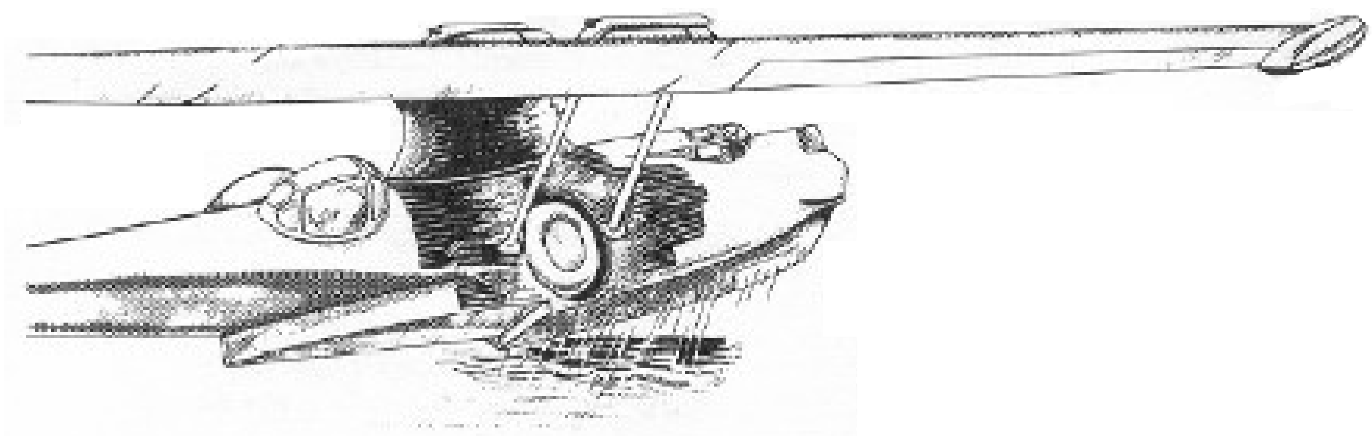



Fig 66

APPENDIX “A”

# Chapter 5
# FLIGHT OPERATIONS



## TABLE OF CONTENTS



## APPENDIX



## SUPPLEMENT

# LAND FLYING

## FLIGHT OPERATIONS

## 5.0 LAND FLYING

a. **PRE-FLIGHT CHECKS-** It cannot be too strongly stressed that poor pre-flight inspection of aircraft has been responsible for many aircraft accidents. Detailed external and internal check lists have been laid down; these should be carefully followed.

Further, flying boats and seaplanes are more exposed to hull damage, the corrosive effect of salt water, and other hazards not usual in landplane operation. Therefore, extra care should be taken in pre-flight inspection of seaplanes and flying boats to ensure the most efficient and safe operation.

In the past Canso aircraft have sunk on take-off owing to the omission of a very elementary external check. This happening, if survived by the pilot, could have a very serious effect on his career. Missing rivets, loose nose wheel doors, unlocked hatches, open ventilators are only a few of the many small things which seriously affect the safety of a Canso aircraft. Close attention to check lists devised by experienced pilots can go a long way towards eliminating needless accidents.

b. **TAXIING** (Land) **-** Taxiing a Canso on land is a simple operation. Since the engines are close together, differential throttle is not as effective as in most twin engine aircraft. Rudder effect is negligible and consequently it is best to taxi with the rudder in the locked position. During windy conditions it is dangerous to taxi with the rudder in the unlocked position because of its size and the fact that it is almost impossible to hold and, at the same time, operate the brakes properly. The brakes are powerful and sensitive, making it an easy matter to taxi in a straight line with only the barest touches of brakes to keep the aircraft straight. Another reason for keeping the rudder locked while taxiing is that, because of the large rudder travel, it is often difficult to apply brake effectively or evenly in the full left or right rudder position, and even more difficult to apply full brake in the intermediate positions. The brakes should be tested immediately when the aircraft begins to move. The time to discover brake unserviceability is on the line.

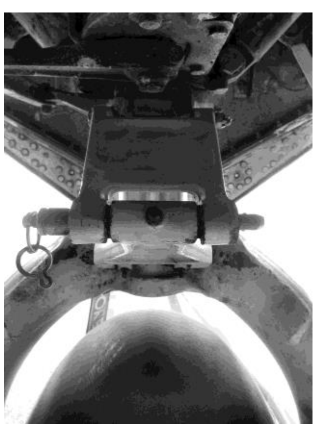


Fig 67

The nose-wheel is designed to caster 30 to either side of the center-line. Whenever it is necessary to exceed this amount, the nose-wheel oleo scissors-bolt is easily removed as it is locked with a spring safety-pin. When parking, the nose-wheel should be lined up fore and aft so that it will resist any weather-cocking effect created by a cross-wind and also to make either a right or left turn possible when taxiing is started. Before attempting to taxi the airplane, the scissors -bolt should be checked to see that it is in place and the angle

## FLIGHT OPERATIONS

### LAND FLYING (CONTINUED)

of the nose-wheel noted. If the nose-wheel is canted to the opposite side to which an immediate turn is to be made, it is preferable to line it up manually with a bar inserted into the axle rather than to force it around by differential

engine and brake. When moving the airplane from one parking place to another with the interior control locks in place, it is preferable to operate the airplane from the right hand seat leaving the control lock bar in place. However, for extensive taxiing the locks, including the rudder lock, should be removed. The purpose of the rudder lock is to prevent damage to the rudder caused by wind when the aircraft is unattended. It was never intended for the rudder to be held in neutral by the lock with steering being accomplished by violent use of the brakes and engines. The airplane is quite easy to taxi with differential use of the engine and full rudder application assisted when necessary by moderate use of the brakes. If the airplane should become stopped by the main-wheels sinking into soft turf or sand, do not compound the problem by using engine power to attempt to move it. Extra thrust with the main-wheels stuck will only dig the nose-wheel in deeper.

c. **TAKING OFF -** Needless to say, the vital actions drill is the most important part of the take-off sequence. These should be known by heart since on water it is not always possible to use a check list.
The Canso is equipped with a tricycle undercarriage and consequently is not subject to ground looping tendencies. This is due to the fact that deceleration forces acting on the main wheels are behind the centre of gravity, tending to straighten the aircraft out. To assist this tendency and also to reduce wear and tear on the nose wheel, the nose wheel should be lifted as soon as possible during take-off.

d. **PRE-FLIGHT CHECKS -** It cannot be too strongly stressed that poor pre-flight inspection of aircraft has been responsible for many aircraft accidents. Detailed external and internal check lists have been laid down; these should be carefully followed.

Further, flying boats and seaplanes are more exposed to hull damage, the corrosive effect of salt water, and other hazards not usual in landplane operation. Therefore, extra care should be taken in pre-flight inspection of seaplanes and flying boats to ensure the most efficient and safe operation.

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## FLIGHT OPERATIONS

### LAND FLYING (CONTINUED)

safety of a Canso aircraft. Close attention to check lists devised by experienced pilots can go a long way towards eliminating needless accidents.

e. **TAXIING -** Taxiing a Canso on land is a simple operation. Since the engines are close together, differential throttle is not as effective as in most twin engine aircraft. Rudder effect is negligible and consequently it is best to taxi with the rudder in the locked position. During windy conditions it is dangerous to taxi with the rudder in the unlocked position because of its size and the fact that it is almost impossible to hold and, at the same time, operate the brakes properly. The brakes are powerful and sensitive, making it an easy matter to taxi in a straight line with only the barest touches of brakes to keep the aircraft straight. Another reason for keeping the rudder locked while taxiing is that, because of the large rudder travel, it is often difficult to apply brake effectively or evenly in the full left or right rudder position, and even more difficult to apply full brake in the intermediate positions. The brakes should be tested immediately when the aircraft begins to move. The time to discover brake unserviceability is on the line.

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g. **CLIMBING -** The most efficient speed is 85k to 90k although the aircraft can climb at lower speeds. At speeds below 85k the aircraft mush’s slightly and the rate of climb is reduced. Also, cylinder head temperatures tend to build up. Individual Cano’s have different characteristics and it is often necessary to experiment with each one at speeds between 85k and 90k to find its best climbing speed.

h. **STRAIGHT AND LEVEL FLIGHT – TURNING -** The Canso, having a tendency towards instability, requires constant movement of the controls, particularly of the rudders, to maintain straight and level flight. For example, banking the aircraft to swing to the left owing to aileron drag; it is nearly impossible to fly in a straight line without using the rudder. In straight and level flight the wings should be kept level and the heading held with rudder.

Similarly, to turn properly it is necessary to lead with rudder on the initial bank in order to keep the ball in the centre. Once the turn is initiated, less rudder is necessary.

## FLIGHT OPERATIONS

**LAND FLYING** (CONTINUED)

During the turn the bank is kept constant with ailerons, and the ball kept in the middle with rudder. If the bank is kept constant throughout the turn, it is easy to maintain a good turn with judicious use of the rudder.

i. **DESCENDING -** Letting down in a Canso is similar to letting down in other types of piston engine aircraft. Experiment will show the best throttle setting for any particular desired descent; generally, 15" to 20" MP is recommended. Approximately 12" is desirable for an approach at 90k at 500 fpm. Care should be taken to avoid carburetor icing on a long descent.

j. **APPROACH AND LANDING -** Since the Canso stalling speed ranges from 58k to 67k (depending on all-up weight), 80k is considered to be the critical speed for single engine, with full power applied. Providing conditions are right, and the aircraft is flown smoothly, the Canso can be flown at speeds as low as 75k with full power on one engine only. With normal rated climbing power (35" MP and 2300 rpm) good control can be maintained at 75k although the aircraft is sluggish and does not perform nearly as well as at 80k or more.

Despite the foregoing, it has been found by experience that the best approach speed for land or water on a normal length runway is 90k. This allows for the throttles to be completely closed on rounding out over the button, giving considerable floating action with plenty of time to adjust for a smooth landing. Response to the controls at this speed is positive with no mush effect. Good landings can be done at lower approach speeds, but the pilot must be prepared for a certain amount of mush which makes a smooth landing more difficult to achieve. Since the Canso is not equipped with flaps, care must be taken not to make too high an approach. On short runways this could be hazardous.

It should be noted also that this aircraft lands in a flying attitude and consequently has very little or no braking effect.

k. **PRECAUTIONARY OR SHORT FIELD LANDINGS–**Landing on runways of 2500 feet or less would be difficult at the above approach speeds. In a precautionary landing the approach should be made as low as possible with plenty of power. As the button is approached the speed should be reduced to 75k. By the time the aircraft comes over the button the speed should be 70k, with plenty of power. The power should be cut immediately the button is crossed, and the aircraft drops.

l. **FORCED LANDING PROCEDURE – LAND** In the event a forced landing is inevitable as the result of loss of both engines or other reasons, the following instructions will serve as a guide in directing the action of the Flight Officer. It is not considered advisable or feasible to set down definite rules or procedures in an effort to entirely cover such a grave situation, as circumstances and conditions will influence the decisions made by the Captain whose prime consideration will be the safety of his passengers. The Captain will, as quickly as possible, select the most suitable area in which to effect the landing, providing the radio station, to which he has been tuned, with as much pertinent information as it is possible at the time. The First Officer will. if time permits, make a survey of engine controls and instruments in an endeavour to establish the cause of the engine failure - if this has not already been determined. The First Officer will switch on passenger warning light, advising crew man if possible. Heater switches — Off. Captain should, if possible, get to the leeward of the area chosen for the landing. For such emergency landings, the undercarriage should be retracted unless the Captain has no doubt about being able to effect a normal safe landing with gear extended. Such action might be justified, for instance, in the event that a landing is to be made on the frozen surface of a lake familiar to the Captain as to thickness of ice - depth of snow, etc. The importance of reducing drag as much as possible cannot be over-emphasized, and undercarriage must be fully retracted until such time as they are required for landing.

m. **TOWING** The Canso is normally towed with a special tow-bar that fits onto the axle of the nose-wheel. Before towing the aircraft in this manner, the scissors bolt must be removed. This enables the nose-wheel to castor beyond the maximum 30 degree limit. If the bolt is not removed and the wheel is turned beyond the limit, damage results. when operating away from base it is the responsibility of the Captain to see that the scissors bolt is removed before towing and replaced before taxiing. If the main wheels become stuck in soft ground, it is good practice to place heavy planks in front of the wheels before attempting to tow it. If it does not move readily, it may be better to move the aircraft backward. In this case, in order to avoid straining the nose gear attachment, a bridle should be placed between the main wheel trusses and the tow bar attached to the half-way point. This method may be used for forward towing as well. In either case the apex of the V point of the bridle should be at least fifteen feet forward or aft of the main wheels. The bridle should be heavy nylon rope. Personnel should not be allowed near it when it is under tension. when the aircraft is under tow, a qualified person should be in the pilot's seat to operate the brakes if required.

If the aircraft is heavily loaded, 75k should be the minimum speed. Considerable braking action is necessary to stop in less than 2000 feet.

# WATER FLYING

# FLIGHT OPERATIONS

## WATER FLYING

### STARTING, RUNNING-UP, AND TAKING OFF: WATER

5.1 **GENERAL -** When a Canso is on the water, in the eyes of the law it becomes a marine vessel, and as such is subject to all marine regulations. Regulations involving right of way should be particularly noted.

a. **STARTING AND RUNNING UP ON WATER -** The starting procedure for water is similar to that for land. The main feature is that once the engines are started, the aircraft begins to move. This makes it necessary for the pilot to maintain a sharp look out during warm up.

After the aircraft is clear of all obstructions, the engines are run up in normal fashion, one at a time, while the aircraft turns in harmless circles. The engines can also be run up together providing that the co-pilot holds the control column back and a sharp look out is kept for obstacles ahead.

b. **TAXIING -** The Canso, unlike float planes, has no water rudders and is manoeuvred on the water by a combination of differential throttle, rudder, ailerons, lowering the undercarriage and the use of drogues or sea anchors. Much practice is necessary before a pilot becomes proficient in this art. The art of taxiing on water is in being able to maintain full directional control at low speeds. Since the engines are close to the centre of thrust, it is necessary to rely on other means of keeping the aircraft straight when approaching a dock or beach. Keeping the aircraft straight at high speed presents no problem on water.

Taxiing into wind is an easy matter since the aircraft has a natural tendency to weathercock into the wind. For this manoeuvre, the stronger the wind the better. In winds of 12k to 15k or more the aircraft can often be brought to a dead stop with the engines idling, which gives a definite advantage to the pilot. Once the engines are stopped, the aircraft is at the mercy of the wind and tide and often reacts far differently from what is expected. Rudder and elevator are most effective when the aircraft is being taxied into wind. The ailerons are useful, not in causing drag, but in putting one wing down allowing the float to go more deeply into the water increasing the resistance and assisting in turning the aircraft.

Taxiing across wind is more difficult in that the aircraft tends to turn into the wind. It is then necessary to apply more throttle to the upwind engine in order to counteract this weather-cocking, causing the aircraft to move faster than is desired. In light winds it is often possible to taxi at low speeds without resorting to the use of drogues and other devices. In very strong winds it is often impossible to taxi the aircraft across wind and the pilot must resort to a system of "tacking" in which he shuts down his engines and drifts downwind as far as possible, restarts and tacks at an angle to the wind.

# FLIGHT OPERATIONS

**TAXIING** (continued)

Lowering the undercarriage is helpful in any form of taxiing, since it reduces the speed of the aircraft, increases lateral stability, and shortens the radius of turn, not to mention the protection it offers against reefs and shallow water. Some Cano's are now modified to allow individual selection of the wheels. The streaming of drogues is another method of maintaining lateral stability in a cross wind, besides helping to slow the aircraft. With one or two drogues streamed on the leeward side of the aircraft, it is possible to maintain full control at low speeds and avoid either fouling up the leeward engine from idling too long, or overheating the windward engine from taxiing at too high a boost. In taxiing long distances, the aircraft engines should be run at approximately 1000 rpm; at this rate they can be run indefinitely without either fouling or overheating.

Drogues are usually used in pairs when taxiing into wind or downwind, and individually when taxiing crosswind. They will be discussed more fully in the section on beaching, mooring, and docking. Drogues are among the most useful items of equipment on a flying boat, and the pilot should use them as much as possible, otherwise he may find that he is not sufficiently experienced in their use when an emergency arises.

In taxiing downwind, the pilot discovers that his difficulties increase in direct proportion to the strength of the wind. Taxiing downwind in a light breeze is usually not too difficult, particularly if the pilot is going straight downwind with his tail in the eye of the wind. He usually finds that it is rather difficult to get the aircraft going straight initially, b4 once downwind he finds that bursts of power judiciously applied keeps him straight. If he allows his tail to wander out of wind he must apply several times as much power to straighten out again. If the pilot experiences any difficulty in keeping straight, he should lower his undercarriage to avoid heating his engines. If he still has difficulty, he can stream both drogues. With drogues streamed and undercarriage down, the Canso may be taxied downwind with little difficulty in fairly strong winds.

If, at this point, the pilot is still unable to maintain control, he should realize that he is involved in very strong winds, and it would be advisable for him to turn the aircraft into wind with his engines idling and control column back, and "sail" the aircraft. He can then move backwards or forwards, or laterally sideways at will.

In summary, under reasonable conditions the aircraft can be taxied in any direction without the use of wheels or drogues if it is not necessary to go slowly. Immediately when seen that undue strain on the engines is likely, the undercarriage should be lowered to provide drag and lateral stability. Drogues may be used in place of undercarriage in certain circumstances, or both may be used at the same time. The control column should always be held back when taxiing in rough water or when using considerable throttle.

## FLIGHT OPERATIONS

**TAXIING**(continued)

In strange waters, ***THE AIRCRAFT SHOULD BE TAXIED WITH THE UNDERCARRIAGE DOWN*** as a safety precaution to prevent rippling the hull on an uncharted shoal.

***IT SHOULD NEVER BE ASSUMED THAT THE UNDERCARRIAGE IS UP AND LOCKED AFTER TAXIING. A COMPLETE CHECK MUST BE CARRIED OUT PRIOR TO ANYTAKE-OFF***. This may be vital.

c. **TAKING OFF** (NORMAL OR LIGHT WIND CONDITIONS)

A complete take-off check must be done immediately prior to take-off. Since the aircraft is moving and since the pilot must keep alert for floating objects and other hazards, it is easy to miss an important check if extra care is not taken. The pre take-off check list, should be adhered to. After completing the run-up, the best procedure is to bring one throttle back, open the other and allow the aircraft to circle while the check is taking place. By this method the possibility of striking a shoal or floating object is minimized since the aircraft is turning in its own track.

The aircraft should be taxied into the wind for a few seconds until it is past its own swells. The control column is held fully back BEFORE advancing the throttles fairly rapidly to 48" MP.

At this stage of take-off, the windshield wipers should be operating as it is impossible to see until the aircraft begins to climb up on the step. If the windshield wipers are inoperative it is necessary to keep the aircraft straight by use of the directional gyro until the aircraft is far enough up on the step for most of the water to have blown off the windshield.

The aircraft very rapidly begins to "rear up" and when it is apparent that it is on the step, the control column should be eased forward until the aircraft is hydroplaning smoothly along the water in a slightly nose-up position. By adjusting the position of the nose slightly, the best angle for acceleration may be felt. If the nose is too high, the acceleration will be slow and the aircraft will tend to stall off the water below flying speed. If the nose is too low, the aircraft will tend to "porpoise" causing a reduction in speed and a strain on the nose wheel doors. If porpoising develops, there is only one way to stop it - pump-handling only makes it worse - and that is to ease gently back on the control column until the action stops. Then the control column may be adjusted forward slightly for best acceleration.

Providing the wings are kept level, it is an easy matter to keep the aircraft straight during take-off by use of the rudder alone. A point directly ahead on the far shoreline or a gyro heading should be noted immediately prior to take-off and held. Immediately full power is reached, the full force of the propeller wash is directed to the rudder, allowing strong positive rudder action.

## FLIGHT OPERATIONS

### Taking-Off (continued)

It is important to keep the wings level during a take-off since a dragging float can cause a strong turning movement. To those pilots converting to Canso's and not familiar enough with the aircraft to feel when the wings are level, the following procedure is recommended.

The position of the port float should be checked during take-off. It should be just above the water when the aircraft is on the step. If it seems unreasonably high above the water, it is possible that the starboard float is dragging If the port float is dragging, it will naturally be quite apparent. If at any time during a take-off, the aircraft seems to be yawing off course, it is almost certain that the wings are not quite level and that one of the floats is dragging. If this is watched carefully, keeping straight during take-off should present no problems.

Once the aircraft is hydroplaning on the step the speed builds up rapidly. A lightly loaded Canso comes off the water at 55k to 60k. With heavy loads or at high altitudes often it does not come off until 75k to 80k is attained. Normally, when the air speed is above 55k it is safe to assume that the aircraft can be pulled off the water. If a sudden obstruction, such as a log, appears dead ahead when this speed is attained, a sharp pull on the control column causes the aircraft to become airborne. The aircraft may not stay airborne but at least the obstruction is avoided.
Normally, easing back gently on the control column causes the aircraft to become airborne at 55k to 60k. This attitude should be maintained until the aircraft has climbed well clear of the water and gained a speed of at least 80k. Depressing the nose immediately after take-off at such low speeds could have disastrous results.

The floats are then raised and the aircraft climbs away at 85k to 90k. The floats should not be raised while the aircraft is still on the step for two reasons:

(1) If the float strikes the water in a partially retracted position may damage the support arms; and
(2) if one engine fails during take-off, the aircraft must be landed straight ahead immediately.

In an emergency, raising the floats immediately the aircraft is on the step is permissible since, with the reduction in drag, greater acceleration can be obtained. Also, taking off in an area of floating ice might make it advisable to raise the floats early in order to offer a smaller target to ice floes. It should be pointed out emphatically that once the floats are retracted the pilot is committed to getting off the water, and only an emergency would justify a change in procedure.

### d. TAKING OFF (GLASSY WATER)

Take-off on glassy water involves the same procedure as above. The following points should be noted, however:

## FLIGHT OPERATIONS

**TAKING OFF (GLASSY WATER)** (continued)

(1) The aircraft has a tendency to "stick" to the water and often considerable force must be applied to the control column to pull the aircraft up.

(2) The airspeed should be watched carefully since a longer take - off run becomes necessary if the pilot attempts to pull off prematurely.

Once the aircraft leaves the water there is no way for the pilot to tell how high he is. Therefore, *he* should carefully maintain this attitude until a definite indication on the altimeter shows that he is well clear of the water: attempting to level out is a very dangerous procedure. Glassy water is a much more solid substance than it looks and is far more dangerous to strike at the wrong angle than rough water. Rough water consists of a series of waves with air spaces in between. Glassy water is solid and can rip the nose out of an aircraft in a twinkling if the pilot is unfortunate enough to strike it in a nose-down attitude.

It is often difficult to get a heavily loaded flying boat or sea-plane up on the step during take-off: it ploughs through the water for some distance. One method of getting the aircraft on the step is to rock it. This involves coarse manipulation of the control column fully forward and fully back until the aircraft begins to porpoise. To stop the porpoising action the control column is held back and the aircraft appears to get on the step more quickly than in the normal method of taking off.

It may well be that this procedure assists the take-off of certain types of float plane, but experiments during previous Flying Boat School courses have indicated that the advantage in "rocking' a normally loaded Canso onto the step is mainly psychological. In timing many take-offs with the same aircraft using both methods it was found that it took exactly the same length of time for the aircraft to become airborne. Experiments were not carried out with overloaded aircraft, so there may be some merit in the method: at least it can cause no damage.

Once the aircraft is on the step the attitude is very important. If the -nose is too low water drag increases, if the nose is held too high induced drag increases. In both cases acceleration is slow and take-off run is increased.

e. **TAKING OFF (CHOPPY WATER)**

For the purpose of this section "choppy water" may be defined as water with small whitecaps in winds of 12k to 15k. Swells and rough water are discussed later.

Again the procedure for taking off is similar to that under ideal conditions. There is usually more spray during the first part of the takeoff but the aircraft attains the step much more rapidly. Once the aircraft is on the step, care should be taken to eliminate all porpoising early to avoid premature bouncing. The attitude is carefully adjusted for the best acceleration. The aircraft should not be allowed to be thrown into the air by

## FLIGHT OPERATIONS

**TAKING OFF (CHOPPY WATER)** (continued)

wave action, but deliberately taken off when the proper airspeed is reached (55k to 60k).

f. **TAKING OFF (ROUGH WATER)**

For the purpose of this section, "rough water" may be defined as that condition in which the surface of the water is disturbed by waves 3 feet high or more and fairly close together. This condition may be found by itself, or accompanying a swell system. The wind is usually strong, sometimes gale force, which is to the advantage of the pilot.

Waves should not be confused with swells. Waves are usually caused by a local high wind condition, in fairly sheltered waters, and although they offer problems to a flying boat pilot, are not nearly so dangerous as swells, which are caused by disturbances a long distance away and are spaced further apart than waves. Swells are often independent of the local wind condition and can occur on glassy water, much to the consternation of an uninitiated pilot. Combinations of waves and swells, very confusing to the pilot, are discussed in a later chapter.

The technique of taking off on rough water is similar to that employed in normal take-off except for the following:

(1) It is not necessary to hold the control column fully back to get the aircraft on the step. Immediately the throttles are opened the nose rises owing to the action of the waves. It sometimes takes considerable strength to force the nose down to the proper position on the step.

(2) As each wave passes there is a tendency for the nose to drop. Therefore the position of the control column has to be adjusted quite rapidly in order to avoid either "digging" the nose, or allowing the nose to rise too high, which results in the aircraft starting to bounce before it reaches flying speed.

(3) If the aircraft does leave the water before flying speed is reached, the pilot has only two choices:

(a) abort the take-off and "stall" the aircraft in, or

(b) Attempt to gain speed between bounces and finally take off. If he chooses

(c) the pilot must check back very slightly just as the aircraft starts descending so as to lessen the impact with the water and keep the nose up. Under no circumstances should the pilot try to force the aircraft back on the water after bouncing first occurs. This leads to violent digging of the nose, water-looping and possible destruction of the aircraft.

## FLIGHT OPERATIONS

### TAKING OFF (ROUGH WATER) (continued)

The pilot should attempt to get the aircraft into the proper flying attitude, on the step, and keep it on the water until a speed of at least 55k to 60k is attained. Once this speed is reached the aircraft should come off quite easily. If it bounces at this point the control column should be brought back to avoid further contact with the water. Under normal loading the Canso is not likely to strike the water again, and should become airborne after one bounce.

The tops of waves close together offer a fairly level surface and, if the aircraft is manipulated properly, should not hinder a successful takeoff. Also, the wind is invariably strong, which means that a very short time elapses before attaining flying speed: in a 30k wind, a ground speed of only 25k is required for take-off.

### g. TAKING OFF (SWELL CONDITIONS)

Swells generally occur in the open sea or in very large bodies of water. Long, low swells, which are often hidden by a "chop" are sometimes present in large bodies of water. A light swell is usually not noticed until the aircraft is on the water, and often surprises pilots by causing a bounce on relatively calm water.

When taking off into a light swell, the same technique as in rough water should be observed, that is, to maintain the proper take-off attitude at all times until flying speed is reached. By dexterous handling of the controls this slightly nose-up attitude can be maintained as the aircraft accelerates despite the fact that it appears to be going up and down over a series of gentle hills

Larger swells should be treated with great caution, and under no circumstances should a take-off be attempted into a heavy swell system. If absolutely necessary, the take-off should be made parallel to the swells, even if cross wind. This is discussed in greater detail in the section open sea landings and take-offs. In general, it should be remembered that a seaplane or flying boat can be landed in conditions in which it is sometimes impossible to take-off.

# FLIGHT OPERATIONS

## 5.2 NORMAL AND GLASSY WATER

### a. GENERAL CAUTIONARY NOTES

The prime objective in landing a flying boat or sea plane is to make the transition from air to water as smooth and gentle as possible. There is a particular angle of attack at which a Canso reacts best on a water surface. This angle occurs at approximately 75k and is such that the only part of the aircraft that touches the water is the rear part of the step, several feet BEHIND the centre of gravity.

At speeds greater than 80k the angle of attack is too flat or even negative and can cause strong deceleration forces to occur ahead of the centre of gravity. Coming into contact with the water in this attitude is dangerous since the nose-wheel door may cave in, owing to the force of the water, and the aircraft may "water-loop" with disastrous effects.

For example, to gain an impression of the force involved, a person who dipped an oar over the bow of a speed boat travelling at 75k (87 mph) would find the experience regrettable. If the same experiment were conducted over the stern there would be no violent reaction and the oar would skim over the surface.

Therefore, as long as the deceleration forces are behind the centre of gravity, drift which occurs during the landing, automatically corrects itself as the aircraft comes in contact with the water. If the forward part of the aircraft is first to come in contact with the water, violent reactions may be expected. Turning forces may be introduced which are self accelerating and become immediately uncontrollable. A water-loop may well result. This is the highly dangerous effect of poor water technique, and lack of understanding of the very simple principles outlined above.

On the other hand, if the speed is allowed to drop too low before bringing the aircraft in contact with the water, an extreme nose-up attitude results which, while not particularly dangerous, invariably causes the aircraft to bounce in any but the smoothest conditions. Wave or swell action is most conducive to this: it causes the aircraft to leave the water before losing flying speed. "Stalls", "semi-stalls", and "bounces" are discussed in great detail later.

A notion prevalent among the uninitiated that water is soft to land on, is quickly reversed after the first experience of landing in even a light seaplane. The noise and sometimes the force of the impact is startling and it immediately becomes apparent that water at speed, far from being soft, is a potentially dangerous solid. This is particularly true of smooth water owing to its incompressibility; the air spaces between waves in choppy water render it less dangerous although more jarring to land on.

Before any landing is attempted, the landing area must be inspected from the air. A preliminary run at 1000 feet around the area shows up major obstacles and underwater obstructions. A square circuit should be attempted so that the water may be observed from all angles. The strength and direction of the wind may also be estimated during the circuit.

## FLIGHT OPERATIONS

### GENERAL CAUTIONARY NOTES (continued)

Not only the landing run, but the take-off run and any taxiing areas should be particularly noted. If a long stay on the water is planned, an alternate take-off area roughly at right angles to the wind should also be noted. Once the aircraft is on the water the file of visibility is very restricted and the pilot is unable to see underwater obstructions until he is upon them.

A dummy run at 500 feet is sometimes helpful in estimating the wind and water conditions and checking for logs, deadheads, and debris. On calm water a dummy run is sometimes unnecessary since logs and obstructions are easily seen. In choppy conditions it is wise to inspect the landing run several times for small obstructions which might be hidden by wave action.

In a light wind the water is what most flying boat pilots would call ideal. There is enough ripple on the water to make it plainly visible but not enough wave action to disturb the attitude of a landing aircraft. Both power assisted approaches and glide approaches may be done in this type of water condition.

### b. POWER ASSISTED APPROACH

The following procedure is recommended:

(1) Pre-landing check.

(2) Approach at 90k at approximately 12" MP.

(3) Turn into wind at or above 500 feet.

(4) Long smooth round-out initiated at approximately 20 feet above the water.

(5) By the time the round-out is completed, the aircraft should be a foot or so above the water at approximately 80k or slightly less.

(6) Hold off and "feel" for the water. In a perfect landing the airspeed at touchdown is approximately 75k. However, under these conditions it does not really matter if the speed has dwindled, provided that the aircraft comes in contact with the water gently and smoothly.

(7) A slight nose-up attitude should be maintained, and the control column gradually pulled back as the speed decreases. Once the air-speed is below 50K the aircraft cannot leave the water and the control column should be slowly eased back. As the aircraft starts to come down off the step, the control column must be fully back. Smooth water is more dangerous than rough water if the nose digs in. Also, the speed by this time is so low that the rudder and elevators have little effect. ***Water-looping occurs more often near the termination of a landing run than at the beginning.***

## FLIGHT OPERATIONS

### POWER ASSISTED APPROACH (continued)

(8) The control column should be kept back until the aircraft comes to a complete stop. This tends to eliminate spray from the windshield but there is a more important reason: to prevent a water-loop. As the aircraft touches down at a relatively high speed, 20k or 30k sometimes feels very slow to a pilot, particularly after a rough landing in which he has bounced badly. The tendency is to relax once the aircraft has bounced for the last time and finally settled in the water at what appears to be a very slow speed. The pilot might allow the control column to go forward, thinking that his landing is finished. But because the water is rough, or more likely because his landing was rough, he fails to notice that he is still up on the step, or just barely off and the aircraft still has considerable forward speed. ***THIS IS ONE OF THE MOST LIKELY TIMES FOR A WATERLOOP TO OCCUR***. Therefore, to be safe, the control column should be kept fully back until the aircraft is stopped.

### c. GLIDE APPROACH

A glide approach is used in order to land on a lake or inlet where the approach is over hills or high trees. It is not recommended on rough water and is usually fatal on glassy water. A glide approach is seldom necessary, since a body of water which calls for a glide approach would probably be too small for a take-off. But, when a landing is made over a shoreline where it is desired to beach or dock the aircraft, it is often expedient to cut down the amount of taxiing time by landing as short as possible.
A Canso, never very responsive, tends to mush at low speeds. Therefore,the rule in glide approaches is to approach at a higher speed than normal and to allow for a long, gentle round-out. Diving at the water and rounding out at the last second is considered highly dangerous since it is easy to misjudge the height above water. Again, if the speed is below 80k and the aircraft hits the water too hard, it merely bounces, owing to the attitude; but if the speed is above 80k it is possible to dig in and water-loop.

Therefore, the procedure for a glide approach is as follows:

(1) The approach should be 95k or more. 100k is desirable if heavily loaded. (The more speed, the flatter the final approach and the longer the period of float. This makes it easier to judge height before the actual touchdown).

(2) A gentle round-out is begun 20 to 30 feet above the water. The closer the aircraft gets to the water the flatter the angle of approach should be. No violent handling is necessary. The aircraft should be a foot or two above the water on completion of the round-out and flying at approximately 80k. Under no circumstances should the aircraft be allowed to touch the water at a higher speed than 80k.

(3) Procedure continues as for a normal power assisted landing.

**Note:** If the pilot cannot determine his height above the water at any time, he would go around again and proceed with the glassy water technique.

# FLIGHT OPERATIONS

## GLIDE APPROACH (continued)

On contact with smooth water the nose always tends to dig in. Therefore, a slight back pressure on the control column is necessary on contact with the water. On choppy or rough water, owing to the wave action, the nose tends to rise, and a very slight forward pressure is necessary on initial contact. On smooth water the control column should never be moved forward and on rough water only with great care, making sure that the nose of the aircraft never goes below the proper attitude.

### d. MODIFIED GLIDE APPROACH

In the modified glide approach the advantage of the steep glide approach is combined with the ease and accuracy of a power assisted approach, particularly with a loaded aircraft. The procedure is as follows:

(1) Approach at 90k with throttles closed.
(2) Round-out should be begun at 15 to 20 feet and a little power applied. An experienced pilot should be able to "feel" the correct amount of power but 12" MP is about right.
(3) Procedure continues as for normal power assisted approach.

There is often unlimited space on water and the pilot can afford to use more than the average runway length in accomplishing a smooth landing. These expanses of water offer an opportunity to a pilot to develop his depth perception to a degree where he is able finally to perform a smooth landing in a minimum of space. It is better for a pilot to take his time and use up an extra half-mile of water in order to meet the water smoothly and gently, than to be impatient and ruin an otherwise good landing.

A landing flying boat or seaplane should be going exactly parallel to the surface of the water at the moment of touchdown. Any sudden dropping is liable to cause a "bobbing" motion, which in certain conditions is sure to cause a bounce.

### e. GLASSY WATER APPROACH AND LANDING

It may be safely stated that "glassy" water is the most dangerous type of water with which a seaplane pilot can come in contact if he uses the wrong technique. At least rough seas are plainly visible, giving the pilot a chance to estimate his height. Glassy water, on the other hand, is dangerous in that it is impossible to see. Unfortunately, there are pilots who believe that if they get close enough to it they will eventually see it. Many cases are on record of pilots hitting the water without making any attempt to round out with fatal results.

## FLIGHT OPERATIONS

### GLASSY WATER APPROACH AND LANDING (continued)

There has been much written on the subject of glassy water landings, and long before the days of instrument flying, bush pilots evolved techniques of landing on glassy water without mishap. These techniques usually involved landing close to a shoreline or to some object so that the height of the aircraft above the surface of the water might be estimated.

Another simple method used often in seaplanes was to reduce power and speed until the nose was above the horizon, and make a controlled descent by use of the throttle until the aircraft came in contact with the water in a tail-down attitude.

These landings were good or bad, depending on the proficiency of the pilot, but were always safe, as the aircraft contacted the water in a definite nose-up attitude.

The method recommended is a development of the latter. It involves use of the artificial horizon, airspeed indicator, vertical speed indicator, and manifold pressure gauge. In other words, it is an instrument approach, requiring no visual reference to the water and could be performed safely in a dense fog or on a black night provided that the water was clear of obstructions. A lookout ahead by the second pilot for logs, deadheads, and other obstructions is a necessary safety precaution.

After practice a pilot finds that although he is performing an instrument approach, he is conscious of the aircraft attitude by his side vision and can check for obstacles ahead without taking his eyes off his instruments. This does not mean that a pilot can fly partly on instruments and partly visually on this type of approach. Reference to the horizon or distant shoreline (which is equivalent to the horizon) is an excellent method of determining the all important attitude of the aircraft, and ensuring that the instrument settings are giving him that attitude. This attitude, being the most important factor, should be accurately maintained until contact with the water.

Until a pilot is proficient in this type of approach and can be sure of perfect one each time, the glassy water approach should be initiated at or above 500 feet. During the first few attempts the pilot may find that he has lost two or three hundred feet getting settled down. It is plain to see that if such an approach were initiated at two hundred feet, the aircraft might well hit the water before attaining the proper attitude.

Glassy water does not necessarily imply mirror like conditions. Brown river water is often difficult to judge during overcast or hazy conditions. Rippled water is often impossible to judge during a rainstorm. The only safe rule to apply is: **WHEN IN DOUBT A GLASSY WATER APPROACH IS TO BE USED.**

## FLIGHT OPERATIONS

### GLASSY WATER APPROACH AND LANDING (continued)

The following is the recommended procedure:

(1) Pre-landing check.
(2) Glide at 90k to the height at which the approach is to be initiated. (500 feet for students). Fine pitch.
(3) Control column eased back to maintain height. (Trim).
(4) As the ASI moves back through 80k to 18" MP is applied.
(5) If the boost is applied at precisely the instant that the airspeed needle reaches 80k, the needle will continue to 75k and stop.
(6) The aircraft should be trimmed to maintain exactly 75k, or at least between 75k and 80k. Under no circumstances should the airspeed be allowed to go above 80k.
(7) After a few seconds for the aircraft to settle down the rate of descent is observed. In a moderately loaded Canso (25000 to 28000 lbs) the rate of descent should be 150 to 200 fpm. The throttle may be adjusted slightly at this point to increase or decrease the rate of descent.
(8) Excessive throttle handling may ruin the approach. Consideration should be given to the lag in the vertical speed indicator.
(9) The aircraft should now be settled and perfectly trimmed for 75k and 150 to 200 fpm descent. The attitude of the nose is quite high.
(10) The pilot should not look at the water.

Serious accidents have been caused by pilots who, at the last moment, decided that they were almost on the water, pulled off their power and rounded out. This can cause the aircraft to stall in from a great height. The altimeter can be several hundred feet out with regard to sea level, and any amount on lakes. Map spot heights are not reliable for lakes. Some of these have been found to contain up to two hundred feet error on the latest aerial maps.

Sometimes when a little too much power has been applied, it is found that a few inches from the water the Canso refuses to touch down, having built up a cushion of air next to the water. This can be overcome by gently reducing power until the aircraft settles on to the water.

### f. GENERAL RULES FOR GLASSY WATER LANDINGS

The list of points given below is intended to help pilots in negotiating glassy water landings.

(1) No reliance should be placed on depth perception.
(2) Looking down only confuses and should be avoided.
(3) Flight should be strictly on instruments, using the horizon or distant shoreline as a cross check to ensure the proper attitude.

## FLIGHT OPERATIONS

### GENERAL RULES FOR GLASSY WATER LANDINGS (continued)

(4) The attitude should not be changed to increase airspeed, particularly when near the water. At low speeds, lowering of the nose causes the aircraft to drop suddenly, spoiling the gradual letdown and possibly damaging the aircraft.

### g. TOUCHDOWN

What is done on and after touchdown is as important as the approach itself. On calm water, the nose of the aircraft tends to "dig" and if not checked this action damages the nose doors. Knowing this, an experienced pilot gently checks back just as the aircraft touches, simultaneously closing the throttle. This counteracts the natural "digging" tendency and produces a smooth landing.

The attitude of the aircraft is not as important as when landing in choppy or rough water provided that it is sufficiently nose-up (75k airspeed guarantees this) and that the aircraft touches the water smoothly without dropping onto the surface.

A rate of descent as high as 500 fpm produces a rough landing and possibly a bounce, but does not cause serious damage to the aircraft if the airspeed is low and the nose is high.

If the aircraft bounces on a glassy water landing, the corrective action is as follows:

(1) The aircraft is held off until fully stalled and allowed to sink in a fully stalled condition with the control column fully back

***OR***

(2) Full power is applied for another circuit. The nose should not be lowered below approach attitude until the aircraft is at least 100 feet above the surface.

## LANDING: CHOPPY & ROUGH WATER

## FLIGHT OPERATIONS

### 5.3 LANDING ON CHOPPY WATERS

Fig 68

The normal approach for landing on choppy water is as described in a power assisted approach under light wind conditions. Sometimes a glide or modified glide approach may be necessary, but the round-out and touchdown should always be as follows:

a. The descent is gradually rounded out until the aircraft is in a slightly nose-up attitude a few inches above the water. (75k to 80k for a perfect touchdown). A little extra throttle gives a more gradual round-out and better control.

b. In choppy or rough water, the nose tends to jump upwards, necessitating a slight forward check.

Note: Checking forward too much can be dangerous. It must be remembered that your action here is not to decrease your landing attitude, but to prevent the wave action from increasing it.

c. As the aircraft touches down there is a steady rattle or ticking on the hull. The throttles should be closed immediately and the attitude (slightly nose-up) maintained as the aircraft runs along the top of the water. The bigger the waves, the more the nose tends to jump up and the more necessary it is to check forward slightly as the aircraft hits each wave.

## FLIGHT OPERATIONS

### LANDING ON CHOPPY WATER (continued)

As the aircraft slows down the control column is approximately neutral as the all-important attitude is maintained. On the final half of the landing run, the control

d. Column should gradually be brought back. Once the speed is below fifty knots it is impossible to leave the water, but the most likely time to have a water loop is approaching.

e. On initial touchdown, a pilot has good elevator control: normally enough to correct any inadvertent "digging" of the nose. However, at the lower speeds elevator control begins to drop off, particularly around 30k when the aircraft begins to come off the step, and if the nose of the aircraft digs in at this point, it becomes too late to pull back on the control column.

In any type of landing on water, the control column should be right back from the time the aircraft begins to leave the step until it comes to a dead stop.

The most important factor in landing on choppy water is the ATTITUDE of the aircraft. If the nose is too low, it can be very dangerous. If the nose is too high, the aircraft bounces.

If the aircraft is stalled after a bounce the control column must be right back and firmly gripped otherwise it is wrenched from the hand as the aircraft hits the water. There is no excuse for bouncing more than once. A fully stalled aircraft will not leave the water, although it may appear to be bouncing. This is called "bobbing" since the tail is usually in or very nearly in the water.

## FLIGHT OPERATIONS

### 5.4 LANDING ROUGH WATERS

Fig 69

a. **GENERAL**

As already defined, rough water, as it applies to Canso handling, has waves three feet high or more, closely spaced, in a moderate to strong wind. If this condition is accompanied by swells, it constitutes an entirely different situation, which is described in some detail under the heading of “Open Sea Landings”.

b. **LANDING METHODS**

There are two methods of landing on rough water: by means of a normal power assisted approach, and by what is generally called a semi-stall landing. A third method, usually inadvertent, consists of a power assisted approach, a bad bounce,

## FLIGHT OPERATIONS

### LANDING: ROUGH WATER (continued)

and a stall off the end of the bounce. This has happened to the most experienced of water pilots and is possibly the strongest reason why the stall technique should be fully understood.

c. **POWER ASSISTED APPROACH**

The power assisted approach is similar to that used on choppy water, except that since the nose has a greater tendency to rear up on each successive impact with the waves, it is necessary to hold it down in order to maintain the proper attitude. But this is not as simple as it sounds. If, for example, the control column is held forward steadily after touchdown, far worse results than mere bouncing may ensue. Tremendous forces are involved and the pilot must know exactly what he is doing and what to expect.

The aircraft should touchdown as smoothly as possible in the normal attitude (75k to 80k). The power is taken off immediately the aircraft touches. A series of jolts shake the aircraft, and the nose immediately starts to jump up. The pilot with a sense of rhythm soon learns to feel the rhythm of jolts from each successive wave and check forward slightly as he hits each wave. Between waves he is checking back slightly so that the attitude of the aircraft remains constant. As the aircraft slows down, the interval between jolts becomes longer, and the pilot controls the aircraft accordingly. The airspeed should be checked carefully, and when it is below 50k the control column should be moved steadily back.

In very rough water, the aircraft sometimes appears to bounce, but with a speed below stalling, it does not stay in the air for long. Occasionally a pilot may bring the control column back too soon, and the aircraft leaves the water in one long bounce. The control column should then be held right back and the aircraft "floats" clear of the water until the remaining flying speed is dissipated, and the aircraft settles into the water with no further bouncing. Very rough water merely causes the aircraft to bob up and down considerably.

Only experience can tell the pilot the exact moment at which to cease checking forward and begin the steady backward pull on the control column. It should be noted that it is far less dangerous to check back too soon than to hold the nose too far down and cause dangerous deceleration forces to operate ahead of the centre of gravity. Serious accidents during water landings can be attributed mainly to lack of knowledge of this principle.

d. **STALL AND SEMI-STALL TYPE LANDING**

The only difference between the stall and semi-stall type of landing lies in the matter of the height at which the stall is performed. Many experienced pilots have argued the

## FLIGHT OPERATIONS

### STALL AND SEMI-STALL TYPE LANDING (continued)

merits of one against the other, but the terms have become so interchangeable in the last few years that their exact origin seems to have been lost in obscurity.

For the purposes of this manual, a semi-stall landing is a landing in which the aircraft reaches the stalling speed as it touches the water. A stall landing is one in which the aircraft is fully stalled some distance above the water.

Fortunately, the Canso aircraft maintains a nose-up attitude throughout a stalled condition, provided that the control column is held fully back. This feature is very convenient in performing a stall type landing. The approach for a stall or semi-stall landing can be made at any speed or at any power setting. Unless circumstances dictate otherwise, a glide approach is usually the most expedient.

In a semi-stall landing, the aircraft glides to a point approximately fifteen feet above the surface of the water at which point it is held off until it becomes fully stalled and begins to sink. If performed perfectly the aircraft touches the water exactly at this point. If it touches a moment too soon the aircraft drops rather heavily on the water but does not bounce The latter is an unconscious example of a full stall landing. The advantage in stalling the aircraft a little higher off the water is that the pilot can be sure to avoid bouncing. Also, the forward speed is slightly lower, although the rate of descent is slightly higher.

The pilot has aileron control during the stall and is able to keep his wings level in the normal way. The rate of descent builds up slowly, so that for the first few hundred feet of descent, the rate of descent is less than 500 fpm. Eventually the aircraft reaches a terminal velocity of approximately 1500 fpm downwards but maintains a nose-up attitude and aileron control; at the same time the forward speed drops off considerably.

A stall type landing is usually performed when the water is too rough for a normal type of landing or when a normal landing has produced a large bounce and there is not room enough to go around again. It ensures that the aircraft will get down on the water without leaving it again. A full stall performed well above the water (approximately 25 to 30 feet) is advisable under extremely rough water conditions or in an emergency. The main advantage of this method is that although the downward rate of descent is greater, the forward speed is much less than in the semi-stall. In large swells, the aircraft would, of course, be landed parallel to the major swell system, regardless of the wind (see “Open Sea Landings”).

For fairly rough water or for practice, a semi-stall type of landing is advisable. The following is the procedure for practicing semi-stall landings. (Note: Semi-stall landings should not be practiced on smooth water. It is very hard on the aircraft. Choppy water with scattered whitecaps presents the ideal condition. The reason for this is that smooth water causes considerable pressure on the hull. **See General Cautionary notes, paragraph (6).**

## FLIGHT OPERATIONS

**STALL AND SEMI-STALL TYPE LANDING** (continued)

(1) Approach into wind at 90k (approximately).
(2) Throttle back.
(3) Round-out should be initiated 15 to 20 feet above water.
(4) Height should be held by gently easing back on the control column until it is fully back (before touching the water).
(5) The control column should be tightly gripped making sure that it is all the way back when the aircraft hits the water. (See Glide Approach paragraph (1) (h)).

Stall type landings should be mastered and fully understood, even if only to build up the confidence of the pilot in the aircraft. Although sometimes a little hard on the aircraft, they are invariably the safest way of getting the aircraft down on rough water in an emergency.

### 5.5 OFF-SHORE TAKE-OFF AND LANDING (SWELL CONDITION)

**a. GENERAL**

Successful off-shore take-offs and landings can be and have been made in Canso aircraft, even under adverse weather conditions. However, due to the design and construction of these aircraft, landing and taking-off in the open sea is, at best, a hazardous operation and only justifiable under conditions of extreme emergency.

Much of the information in this chapter is derived from experiments carried out by Commander McDiarmid, U.S. Coast Guard, who performed over 240 off-shore landings during tests for the RAF and USAF.

**b. LANDING SPEED AND SURFACE CONDITIONS**

The higher the landing speed the more violent is the 298ehaviour of the aircraft landing in a sea, and damage to the aircraft, which may adversely affect its hydromantic performance, is to be expected. Because of this cumulative effect, every effort should be made to reduce the landing speed.

Experienced pilot of a seaplane about to attempt a landing in a substantial sea tries to find the lee. Tests have indicated that a ship circling at 12 kts with hard over rudder reduces much of the roughness and swell inside her turning circle after three circles are completed. If there is a ship present, the pilot of the aircraft may be able to get the captain to circle his ship to obtain a much easier landing surface. The pilot can the make his approach, either into wind or with the remaining swell abeam, whichever looks easier, and drop just inside the circle to complete his run before crossing the whole of the circle.

A landing can be made in the lee of a very large vessel if she steams slowly ahead with the sea on her beam. If there is not vessel present or the pilot does not have time to wait for the circle to be made, he must make best of the sea.

## FLIGHT OPERATIONS

### c. SWELL SYSTEM

Commonly, the sea is made up of one or more swell systems roughly from 200 to 1,000 feet from crest to crest, traveling from 20 to 45 kts, and covered by a chip which is driven by the local wind. The swell is not necessarily going with the wind. But is rarely going directly against it otherwise the swell would slowly stop. More often the wind drives the chop across the swell at an angle from 15 to 80 degrees.

Often two swell systems are a few degrees apart, but of greatly different period so that periodically one overtakes the other and forms, momentarily a swell roughly equal to the sum of the height of the two swells forming it. Then, a moment later, the two systems are in opposite phases and the crests of one system fill the troughs of the other and the sea makes a relatively easy landing surface.

The chop is always on top of the swell. Many inexperienced observers think that the chop is the whole of the sea disturbance and credit it with great heights when it forms peaks on top of the in-phase swells. (ie, when one swell overtakes another).

The pilot about to land should observe the swell from about 2,000 feet, for at a lower relative attitude it is almost buried under the chop. He should remember the compass heading from which he observed the most formidable swell system. If there are two formidable swell systems running at an angle from 60 to 80 degrees, he should plan his landing run to go down one and parallel the other, as much into the wind as possible. The wind, unless it is blowing at 20 kts or more, is definitely the last consideration. When touching down on the water he should trim his wings, as long as he has control, to the sea surface under him, not necessarily to the horizon. When landing on the peak of an oncoming swell the point to touch down is at the top or just beyond the top of the swell. The rising side of the swell should be avoided in touching down for the plane is then forced into a radical change of direction which subjects it to very severe shock. After touching down, the nose should be kept up as long as possible. Experiments have proven that landing into the face of a swell constitutes a serious hazard.

### d. GENERATION OF SEAS

Before he is able to judge a sea the pilot must understand the mechanics of its generation, life and dissipation and the effects of one disturbance on another, and finally the effect of the whole considerable distance of the landing run at high speed before coming to rest.

When the wind blows, the drag of the wind on the water builds up waves. These grow higher and higher and the distance between crests becomes greater as they travel along driven by the wind. The distance over which they are driving while building is called the “fetch”. The heights and lengths they attain are proportional to the strength of the wind and the length of the fetch over which it is effective.

## FLIGHT OPERATIONS

### GENERATION OF SEAS (continued)

This is most apparent to a mariner drifting in a small boat or raft on a slick sea with a great swell. He simply rises and falls. Landing in these conditions is like rolling onto a strip with a deep dip or a short rise in it: the aircraft tends to become airborne after rolling up the inclined part. In the sea dips and raises are constantly moving down the runway; the dangers of them may best be avoided by landing on a runway along this side of the swell; This whole runway tilts sidewise and slowly rise and falls as on a longitudinally almost level surface. In action, it gives the aircraft a slight tendency to bounce as it rises and to land above it as it drops away.

The presence of several swell systems moving 30 to 80 degrees apart and possibly of very different heights and periods covered by a formidable chop constitutes a confused sea. The best general rule of procedure here is to land parallel to the more formidable swell system on the heading that takes the aircraft down swell on the secondary system and as much into wind as possible. The order in which the above factors are presented indicates their relative importance, unless the wind is very strong. The pilot may reasonably decide to land into wind if it is 20 kts or above. He should remember that the wind direction is more important with a slow landing plane than it is with a fast one.

In a confused sea, “freak” seas of very considerable heights are to be seen here and there. A pilot should be mentally braced to find one suddenly rising ahead of him very unexpectedly on the landing run. If he sights it in time, it is possible for him to swerve the landing path slightly and miss it.

The fact that landing parallel to or down the back of a long, fast swell in calm conditions is a relatively simple matter. A rough short sea sadly complicates the problem of abandoning the aircraft after ditching. Pilots compelled to ditch should chose an area having little or no surface wind whenever possible.

Many pilots fear crosswind landings on the water and feel that they invite water-looping. Curiously, the sharp jerk felt when a plane is landing crosswind on smooth water is not noticed in rough water, partly because the landing and run-out are rough anyway and probably partly because there is an eddy of wind on the leeward side of a large swell or wave which drags momentarily into the prevailing wind.

The illustrations (Figs 1 to 3) show simply how the profile of a wave is made up. When landing across a swell system (as in figure 4) the little waves (the chop) are crossed very fast and they are felt as hard vibrations and hard bumps, but the long, low, buried swell is the factor that is most likely to throw the aircraft out of control while running fast. It is almost impossible to show in a drawing how a wave and swell system crossing at broad angles affect one another; however, some attempt is made to do so in Figure 5.

## FLIGHT OPERATIONS

e. **DITCHING STATIONS**

On making an offshore landing at sea, crew members and passengers should be warned to take up correct ditching stations prior to landing, and if harnesses are available they should be securely strapped in the islands of safety in the aircraft. Under no circumstances should crew members be permitted to remain in the nose or tail sections during landing.

f. **FORCED LANDING PROCEDURE – WATER** The Captain will advise other crew members of emergency. The crew man will ensure that all safety belts are fastened and that life jackets are worn and properly fastened. Life jackets should not be inflated until passengers are outside the aircraft, as the extra bulk could impede the evacuation through emergency exits. A normal landing will be made and in event a heavy swell is prevailing, the landing is to be made along the swell, in this respect it may be advisable at the pilot's discretion to leave the wing floats in the half down position until after touchdown to minimize the possibility of digging a float into the water.

g. **AFTER TOUCHDOWN** If landing is accomplished safely and aircraft remains afloat, passengers and crew will remain on board. If possible, Pilot will beach the aircraft and take action as the situation demands. If after touchdown the aircraft is damaged to the extent that it has to be abandoned, the Captain will take charge. Crew man will launch rubber dinghy, Co-Pilot will assist passengers to evacuate aircraft. If there is sufficient time, passengers will leave aircraft by passenger entrance directly into the dinghy if possible. Lf aircraft is in danger of sinking immediately, crew will assist passengers through nearest exit. IMPORTANT: Ensure that all life jackets are inflated immediately passenger is outside aircraft. The Captain will ensure that all passengers and crew are accounted for. If on landing the aircraft is damaged to the extent that it is partly submerged, both Pilots will abandon aircraft 'through cockpit escape hatch and endeavour to reach and open all normal and emergency exits from the outside and assist any passengers to the best of their ability. The crew man will endeavour to open emergency and/or normal exits and assist passengers as best as possible. NOTE: Once outside the aircraft the Captain will survey the situation and decide what action should be taken, unless the damage is very severe it may be advisable to remain with the aircraft as a PBY has been known to float for some considerable time, especially if the wing tanks are empty

h. **TAKE-OFF**

A seaplane can be successfully landed on a sea which is too rough to permit a safe take-off. Normally this is due to the length of time and take-off run required to attain airspeed and to become airborne; during this run the aircraft takes a very heavy pounding and may be thrown into the air with insufficient airspeed to maintain control.

## FLIGHT OPERATIONS

### TAKE-OFF (continued)

As in off-shore landings, a sound knowledge of sea and swell conditions is essential and the pilot must use his own judgment about whether to attempt to take-off. During take-off, care must be taken to keep the wings level in relation to the seas under the aircraft, and the control column must be held well back to prevent the nose from digging (See Article 2.07)

### i. JET ASSISTED TAKE-OFF (JATO)

By its extra thrust JATO greatly shortens the critical take-off phase in rough water operations and, even in very rough seas., may assist in the otherwise impossible take-off of heavily laden aircraft. JATO does not reduce the inherent hazard of open sea operations, when they become necessary. JATO also makes it possible to take-off in restricted areas where take-offs under normal power could not be made.

The action of wind on water creates effects which give a definite indication of the wind speed and direction. A light wind forms ripples on the surface (Fig1) and as it increases in strength the ripple grows larger until, at about 8 kts, small waves begin to form. The crest of the wavelets breaks off and slide back INTO WIND as foam. (Fig 2)

Dispersed white caps appear at approximately 15 to 20 kts the sea has a distinctly rough appearance. As the wind speed increases, the waves grow higher until eventually at about 35 kts the crests of the waves are being blown forward as “spindrifts” (Fig 3). With a steady wind this forms regular parallel lines (wind lanes) at right angles to the wave lines (Fig 4).

### j. WINDSPEED TABLE

The table below (Fig 70) details the sea state for various wind speeds.

| Beaufort Wind Scale in Miles per hour (Mph), knots and Kilometers per hour (Km/h) | | | | |
|---|---|---|---|---|
| Beaufort Scale Force | Wind in MPH | Wind in Knots | Wind in Km/h | Description - Wave Heights—Visible Condition |
| Force 0 | 0-1 | 0-1 | 0-1 | Calm; Ht 0.0m ~ At sea no waves - glassy like appearance of sea. |
| Force 1 | 1 - 4 | 1 - 3 | 2 – 6 | Light Airs Ht 0m ~ At Sea wind makes glassy ripples on water. |
| Force 2 | 4 - 7 | 4 - 6 | 7 – 11 | Light breeze Ht 0.1m ~ At Sea smooth wavelets |
| Force 3 | 8 - 12 | 7-10 | 13 - 19 | Gentle breeze Ht 0.4m Slight ~ At sea slight waves no white horses. |
| Force 4 | 13 - 18 | 11-16 | 20 – 30 | Moderate breeze Ht 1m - Slight to moderate ~ At Sea waves described as with occasional white horses.<br>On land raises dust and loose paper; small branches are moved |
| Force 5 | 19 - 24 | 17 - 21 | 31- 39 | Fresh breeze Ht 2m Moderate ~ At sea consistent white horses |
| Force 6 | 25 - 31 | 22 - 27 | 40 – 50 | Strong breeze Ht 3m Rough<br>At Sea large waves start to form, more extensive white foam crests, some blown spray. |
| Force 7 | 32 - 38 | 28 - 33 | 51 – 61 | Moderate (near) gale Ht 4m Rough to very rough.<br>At Sea waves begin to heap up and streaks begin to appear down the waves.<br>On land whole trees in motion; inconvenience in walking against wind |
| Force 8 | 39 - 46 | 34 - 40 | 62 – 74 | Fresh gale Ht 5.5m Very rough to high<br>At Sea waves get longer - crests break into spindrift and the streaks become more pronounced. |
| Force 9 | 47 - 54 | 41 - 47 | 75 – 88 | Strong or severe gale Ht 7m High<br>At Sea high waves and dense streaks of foam may begin to affect visibility.<br>On land slight structural damage occurs; chimney pots and slates removed |
| Force 10 | 55 - 63 | 48 - 55 | 89 - 102 | Whole gale or Storm - Ht 9m Very High<br>At Sea very high waves with overhanging crests, lots of spray makes the sea almost white, visibility seriously affected. |
| Force 11 | 64 - 72 | 56 - 63 | 103 – 117 | Violent Storm Ht 11m Very High<br>At Sea exceptionally high waves and a complete coverage of long white foam patches. All crests blown into froth. |
| 12 | 73+ | 64 + | 118 + | Hurricane Ht 14m plus Phenomenal<br>At sea the air is completely filled with driving spray, visibility extremely difficult.<br>On land devastation occurs. |

Fig 70

## k. **Beaufort Forces**


Fig 71

# FLIGHT OPERATIONS

## BEACHING


Seaplane Pilots Association Australia

## FLIGHT OPERATIONS

### 5.6 BEACHING THE CAT

This pictorial article was originally published in the September, 1943, issue of *Air News* magazine, vol 5, no 3, p 42.

http://rebertsrules.com/LiTOT/Content/1943/PBY_AN_4309_Beaching.html

1 **In beaching** a large flying boat, the first step is to get it properly lined up at right angles to the end of the ramp. A sea anchor, dropped overside from amidships, acts as pivot in tailing the ship in for beaching.

2 **In large flying boats**, another sea-anchor is attached by the ground-crew to aid in making this 90° turn. They also bring the pilots and air-crew members ashore from the Catalina pick-a-back to keep them dry.

3 **By means of a** rope attached to the tail, the boat is turned tail inward toward the ramp. Then ground-crew members, clad in shorts, attach the tail-wheel unit, which acts as steering-device when the boat's ashore.

4 **Next, the wheel units**, consisting of two standard wheels and a regular Aerol strut are clamped into place on fittings provided for this purpose on the hull. These inspired the current amphibian version Consolidated Catalina.

5 **Getting the big boat** the next few feet is a delicate hand operation. Wind and tide can make it complicated, and rough handling can damage the flying boat's valuable hull. For this reason, contact is hand work.

6 **Once the boat** is actually on the ramp, a tractor picks up the rope, and the boat is towed to the washing and service line. All flying boats operating in deep water are washed on beaching to prevent salt water corrosion.

**Beaching the "Cats"**

ADVOCATES of landplanes for future transoceanic operation often point to the complexity of beaching operations as an argument against large flying boats. These problems are numerous, because the large seaplane, lying on surface, is affected by both aerodynamic and hydrodynamic forces. However, skilled and careful beach crews can take the boat out of the water with little trouble and a minimum of time and equipment.

The Navy, through years of practice with water-based equipment, has evolved a procedure which demands the utmost in co-operation between plane and ground crew, rapidly accomplishes the beaching operation with a minimum risk to equipment.

The accompanying series of pictures illustrates the general procedure used at most Naval stations. For instance, a PBY patrol boat comes back after completing its mission. The pilot lands the ship and taxis up-wind at right angles to the ramp, going a little distance beyond it. Arriving at the key point, a member of the flight crew throws out a sea-anchor, a canvas bag which acts both as a drag and as a pivot.

The ground crew, dressed in swimming shorts when the weather permits, or in all-over rubber suits and waders, when the climate is frigid, wade out, and bring the crew in pick-a-back. Then using the sea-anchor as a pivot, the ship is turned, tail toward the sloping seaplane ramp.

In the meantime, a three-section wheeled beaching gear is wheeled out. Consisting of two twin-wheeled units, fitted to a regular Aerol strut, like those used in regular landing gear units, these wheels are equipped with fittings which couple with those on the boat. The tail-wheel consists of a Vee-shaped bracket, with a third prong used for steering the entire unit.

Once the gear is attached, the boat is hand-hauled to the edge of the ramp by means of a rope attached to the tail bracket. Once the boat makes contact with the ramp and is properly lined up, the tow rope is hitched to a tractor, which pulls the PBY out of the water, onto the washing line, where every trace of salt water is washed away. Only then is it ready for servicing, further flight.

Page 42

Figure 72

# FLIGHT OPERATIONS

## a. GENERAL

Beaching is the act of manoeuvring a seaplane of flying boat into a beach and securing it against further movement. The aim of a beaching operation is not to taxi the aircraft toward the shore until it hits the beach; it is not even necessary for the aircraft to ground during beaching. Aircraft ground themselves more often than not but this is not absolutely necessary.

The perfect beaching operation is one in which the aircraft comes to a complete stop still floating and with one wing float over the beach. In this instance, a successful securing manoeuvre can be carried out by one man, provided that the wind is light. On the other hand, if the aircraft has been driven on the beach it takes a larger number of men to pull it off, not to mention possible damage to the hull from stones, gravel or rocks.

The end object of a beaching operation is to have the aircraft secured against the shoreline with the tail over the shore. The aircraft is usually secured by two wing lines and one tail line attached to trees or other immoveable objects.

It is impossible to lay down a series of steps which when followed gives the perfect beaching. Every body of water has its own features. Every beach is different. The change of wind or water current can affect conditions decisively. Therefore, a flying boat pilot must learn to assess each situation as an entirely new situation and learn to expect the unexpected.

Since several men must work together to perform a successful beaching, the captain’s ability to organize and handle his crew has a direct relationship with his success in such an undertaking.

## b. SURVEYING OF THE BEACHING AREA

After preliminary survey of the water body (See Chapter 3) a survey of the beaching area is conducted by flying as low as possible over it without coming too close to such obstructions as high trees and power cable. The following points should be borne in mind during the survey of the area.

(1) Type. Should be free from rocks, shoals and sandbars; preferably it should be sand, gravel or mud.
(2) Protection from the weather. Should be in a cove or on the leeward side of a point or island. Consideration should be given to the prevailing winds. A bluff or trees on the land side affords protection.
(3) Depth of water at the shoreline (slope of beach). If it is tidal water, the range of tide and the proximity of fresh water considerations. Sometimes it is a good idea to take a compass bearing from the beach to the nearest fresh water lake to aid in finding it after setting up camp.

## FLIGHT OPERATIONS

### SURVEYING OF THE BEACHING AREA (continued)

(4) Tie down area. There should be a means of tying the aircraft down close to the camp site.
(5) Provision from moving the aircraft, in the event of gales or floating ice.

### c. WATERBORNE PROCEDURE

After every feature of the water body has been checked (landing and take-off area; the taxi path to beach with its neighbouring obstructions; the beach itself) and the crew briefed on their duties, the aircraft may be landed and beached.

In strange waters the aircraft should be taxied with the wheels down. (See Article 2.03). If it is apparent that wheels up beaching may be carried out, it is a simple matter to circle and approach the beach when the wheels are FULLY UP AND LOCKED. A partial retraction can cause serious damage.

Drogues should be used (See Article 2.03 para (4) & (5)). Under certain conditions it is wise to hold the drogues until the aircraft is line up on its final run as it is sometimes difficult to turn sharply with the drogues streamed.

Before the aircraft gets close to the beach, wing men must be posted and wing lines tied. Sometimes for convenience, a tail line is tied and carried up to that wing tip which the pilot intends to put over the beach. This facilitates turning the aircraft around when ashore.

A SLOW APPROACH is imperative: the slower the better. Normally, when approaching a sandy beach, the wheels are up and the only drag is provided by the drogues. The pilot should manoeuvre so that his final approach path is a straight line. It is very difficult to turn without speeding up slightly, (through having to use power on one engine)

An approach which is nearly parallel to the shore is also desirable where room allows. Such a course in the final stages of the approach offers more opportunity for going around again than a head on approach where, once close in, the pilot is committed for better or for worse.

It should be borne in mind that the end object is to have the aircraft tail-in to the shore, so that the nearer the aircraft approaches this position under its own power, the less manhandling is necessary.

### d. OFFSHORE WIND

Beaching the aircraft in an offshore wind is a reasonably simple operation, provided that the beach is free of obstructions and the approach path is clear. If there is doubt, the wheels should be left down. (The aircraft can always be refloated and the wheels pumped up.) the approach should be at an angle, if possible with one wing float over the

## FLIGHT OPERATIONS

**OFFSHORE WIND** (continued)

beach. One wing man should be stationed as far out as possible on the off-shore wing, and another wing man inboard just outside the engine on the onshore wing. As the aircraft comes to a stop (or grounds) with the wing float over the beach, the onshore wing man goes to the wing tip and the offshore wing man comes in-board, thus lowering the float to the beach and holding the aircraft for a time. The rest of the crew, with the exception of the pilot and flight engineer, then disembark via the onshore wing tip, and turn the aircraft around.

In a very strong wind, when it is often impossible to approach the beach at an angle, a straight-on approach is made with a crew man stationed in the nose of the aircraft. AS the nose grounds, the crew man wades ashore with a line and attaches it to a tree or other object. While this is being done it is often necessary for the pilot to hold the aircraft in the beach with the engines.

### e. WIND PARALLELING BEACH

Ideal conditions for beaching exist if the wind direction is parallel to the beach. The aircraft taxis into wind dead slow until it stops with one float over the beach. In strong winds the engines should sometimes be kept on until the aircraft is partially secured. Again, it is necessary for the crew man to move the wingtip floats up or down on signals from the captain.

### f. ONSHORE WIND

An onshore wind combined with a small beach having obstructions near the waterline, makes beaching a very tricky operation, combined with a long, wide beach, it makes the operation very simple. All that is necessary is to taxi as close to the beach as practicable, initiate a turn into wind, and shut down the engines.

Owing to its natural weather cocking tendencies, the aircraft turns into wind and drifts back on to the shore, tail first. Use of the rudder and ailerons can cause the aircraft to “track” a few degrees either way.

Placing one or more men on one wing tip causes one float to go into the water, setting up a considerable drag and helping to turn the aircraft slightly out of wind. This is called “Sailing” and is an art requiring a certain amount of practice before proficiency is acquired. With a very strong onshore wind (15 to 20 kts or more), the aircraft sails backwards with the engine idling. This contributes an additional safety factor in that the aircraft is always under control and con be maneuvered quickly if necessary.

In conditions of very light onshore winds no attempt should be made to sail the aircraft as the operation soon deteriorates into an aimless drifting 30 to 40 feet from shore. A parallel type of approach with drogues should be employed and an attempt made to put a float over the shore.

## FLIGHT OPERATIONS

### g. OBSTRUCTIONS ON THE SHORE

If there are large boulders on the beach that the float is in danger of striking, the beaching process is slightly modified. The crewman on the onshore wing is waved out and the offshore crewman is waved in. The onshore wing float, now in the water, grounds immediately and hits the shore. The crewman then jumps from or climbs from the wing tip and secure the aircraft

### h. SECURING

Once an aircraft is beached it must be properly secured with lines. The aircraft is manhandled to a tail-in position and lines are attached to rings in the leading edge of the wing and a ring on the underside of the tail. The rings on the rear of the floats are not used for tie-downs owing to the inherent weakness of the structure during side thrust. However, they are sometimes handy for use by a shore crew, being more easily accessible than the fixture in the leading edge of the main plane.

When beaching on a rocky bottom in tidal waters, or where rough water is expected, if the wheels are not already down, the aircraft may be pushed out manually and the undercarriage may be lowered and locked, affording excellent protection against rocks and pounding swells. With a receding tide, the brakes can be set and the aircraft will be left high and dry. ***THE AIRCRAFT SHOULD NOT BE LEFT ON ITS HULL IF THE TIDE IS RECEDING.*** One stone the size of a fist can be forced through the hull if caught between the hull and the beach.

If there are no trees to secure to, there are several substitutes. A Canso anchor, buried at a thirty-degree angle with a cable attached is as strong as the cable itself. Some pilots carry a spare anchor on northern operations solely for that purpose.

“Dead-men” offer another method of securing lines. A dead-man is a log, 4 to 6 feet long, which can ne buried at right angles to the pulling force and has exceptionally good anchoring qualities. If no dead-man are available, it is possible to tie lines around large rocks and boulders, but care should be taken to protect the lines against fraying. A gentle bobbing aircraft can fray a line through in a very short time.

In summary it should be remembered that no two beaching operations are exactly alike, even on the same beach. The qualified Captain, therefore, evaluates each situation before approaching the beach, briefs his crew thoroughly and anticipates difficulties – even unforeseen ones, by allowing himself a way out. On the other hand, the impetuous pilot who does not make full preparation is a potential wrecker.

There are several other methods of beaching a Canso in unusual or difficult circumstances, among which the following are typical:

(1) Anchoring and Winching. A Canso may be anchored slightly offshore and a tail line taken ashore by boat. The aircraft is then pulled gradually onto the beach as the anchor cable is paid out. The advantage of this method is that the aircraft is under control at all times and is less likely to be damaged on a rocky or restricted beach.

## FLIGHT OPERATIONS

**SECURING**(continue)

(2) Reconnaissance by boat. If the Captain is not sure of the beach and if the wind is calm, he may shut down off the beach and dispense with the anchor. A man may

(3) be sent ashore by boat with a line and, after inspecting the beach, haul the aircraft in. If the aircraft is too far out for a line, the captain may restart, after getting the crewman to report on the beach condition, and carry out a normal procedure.

(4) Buoying Offshore. In some localities it is possible to moor the aircraft to a buoy near the shore, then work it onto the beach or dock. The aircraft can then be winched back to the buoy after unloading, reducing the chance of damage.

# DOCKING

## FLIGHT OPERATIONS

### 5.7 DOCKING

#### a. GENERAL

Unfortunately, there are very few docks available which were designed specifically for flying boat operation. Float planes are usually easier to dock than flying boats because of their manoeuvrability on the water, and the ease with which they can be handled by one or two men. Flying boats offer a problem because of their poor maneuverability at slow speed, their wing tip floats which are always in danger of colliding with the dock, and their large size which necessitates the presence of several men for handling, particularly in windy conditions.

A fully loaded Canso weighs approximately 15 tones, which means that collision with an immoveable object, even at one or two knots, is bound to cause damage. If the dock I small and flimsy, a slight bump may wreck the dock completely. On the other hand, the nose of a Canso can be crushed very easily by coming into contact with a solid, immoveable dock.

The problem, therefore, is similar to that in beaching operation except that even greater care is necessary to avoid damaging the aircraft. If the aircraft can be brought to a complete stop a few feet from the dock, it can be considered a perfect docking. The object of the operation is NOT TO HIT THE DOCK.

The proper method of approaching a dock, buoy, or beach is in a long approach AT THE SLOWEST POSSIBLE SPEED, ensuring that the aircraft is under complete control long before the last chance to turn around has disappeared Patience is a virtue in this instance. Many aircraft have been damaged simply because the pilot was too impatient to make another approach, or even several, until he was sure that he was approaching at the best possible angle, at the lowest speed, and under complete control. The long approach is valuable in that it gives the pilot an opportunity to experiment with his controls at minimum speed to assure himself that what he is attempting to do is, in fact, possible under the particular circumstances. If the aircraft is going to swing violently when the throttles and speed are cut right back, the time to find out is well out from shore, so that another attempt can be made using a slightly different procedure.

#### b. TYPE OF DOCK

The ideal type of dock for use with Canso aircraft is a “T” shaped dock extending out from shore at least 50 feet. It should be a floating type projecting out of the water not more than one foot. A dock projecting up to four feet from the water may be used providing the access way is close to water level, allowing the wing tip float to clear it. Any higher obstruction is bound to interfere with the propellers.

Any floating dock which is low and fifty feet clear of obstructions may be considered reasonably safe. A small scow moored to a buoy is usually

## FLIGHT OPERATIONS

**TYPE OF DOCK** (continue)

easy to approach since it is always steamed downwind. Docks which are high and solid, particularly those with an abundance of pilings close by should be avoided at all costs. If it is absolutely necessary to approach this type of dock because of an emergency, the only safe method is to anchor or moor to a buoy well off the dock and then manhandle the aircraft into the dock by use of lines.

c. **APPROACHING THE DOCK**

Docks can be approached on a head-on or parallel course, depending on the current, wind and general situation. Again, as in beaching, it is impossible to lay down a definitive sequence of actions for approaching any dock. For this reason, again, planning, patience and anticipation of all possible hazards are the only safeguards against mishap.

If the dock is being approached head-on, it is necessary to have a crewman in the nose with a length of line and preferably a crewman on each wing, also with a line, to assist in manoeuvring and to guard against unforeseen hazards. To afford more drag and, consequently, greater stability and control, the undercarriage should be lowered. In a head-on approach it is better to UNDERSHOOT than to overshoot. It is much simpler to restart the engines in order to move ten feet than to repair a crumpled nose or wing float.

In a parallel approach, the same principles apply. Every possibility should be covered. The approach should always be made into wind and into the current whenever possible. (A 5kt current has a definitely stronger effect on an aircraft than a 5kt wind. When in doubt a dummy approach may be made well off the dock in order to test control of the aircraft at very low speeds).

In a parallel approach the inshore float must be raised out of the water high enough to clear the dock. This is done by placing the heaviest crewman on the offshore wing, or having the offshore crewman stationed further out on the wing. It should be remembered that this causes a slight turning tendency away from the dock when the engines are cut, due to the drag of the offshore float. This can be compensated for by the use of drogues if necessary. The undercarriage may also be used, but great care must be taken to ensure that the main wheels do not suffer damage from the dock, or vice versa. If the docking is carried out properly, no part of the aircraft touches the dock until the aircraft is fully stopped, then the aircraft is held off the dock and the undercarriage pumped up.

## FLIGHT OPERATIONS

**APPROACHING THE DOCK**(continued)

"sailing" and other tricks can all be used in certain circumstances. But only practice can guarantee the effectiveness of these procedures. The proper place to practice is out in open water where there is no danger of collision – NOT while approaching a dock.

d. **SOUND SIGNALS (WATER)**

1 Short Blast – Altering course to Starboard

2 Short Blasts - Altering course to Port

3 Short Blasts – Engine full astern

5 Rapid Blasts – Danger Signal

Prolonged blast (4-6 seconds) restricted visibility.

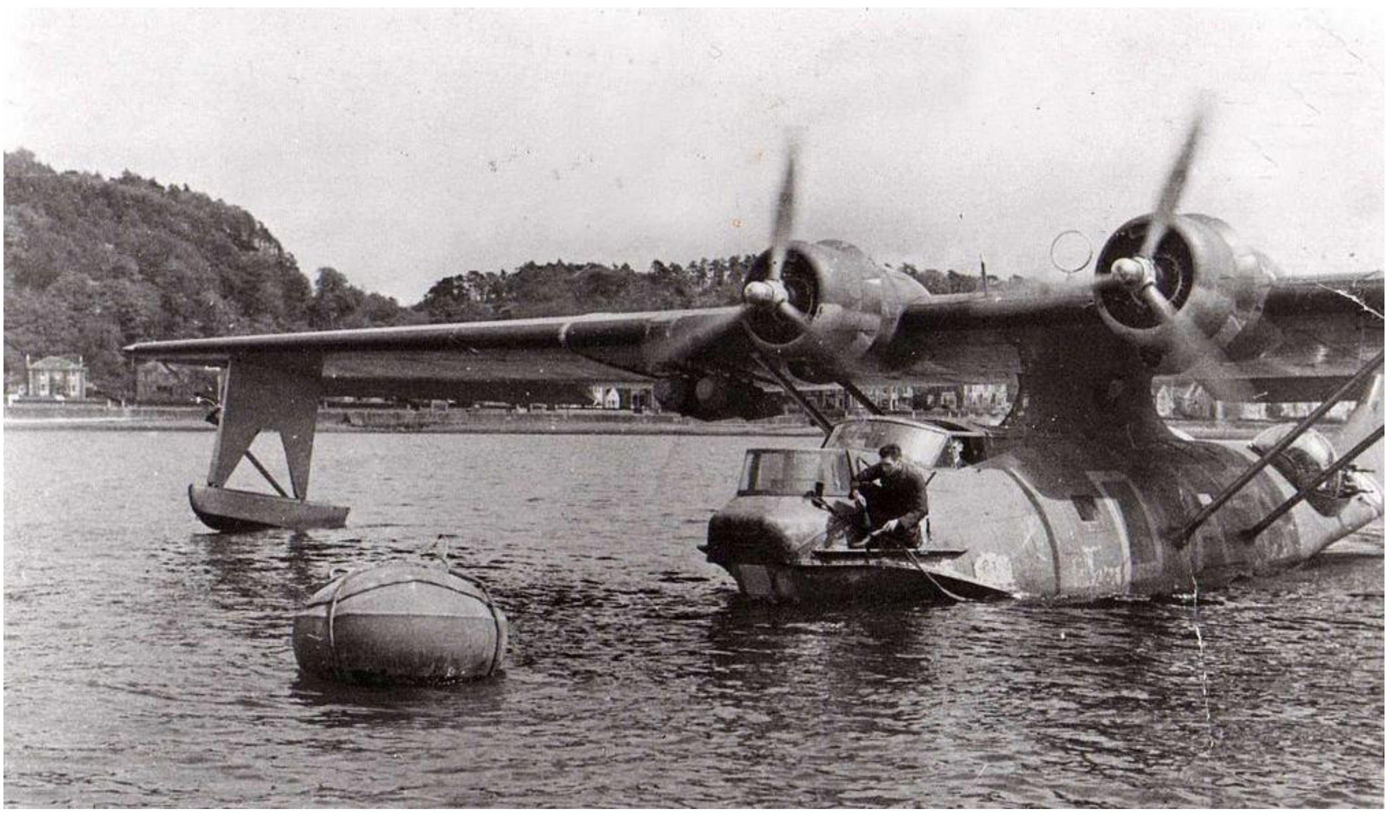
Vessel moving Down Current Has Right of Way

Vessel approaching a blind corner must give a blast of 8 seconds duration.

e. **SUMMARY**

It cannot be emphasized too strongly that each docking is entirely different and that it is the pilot's responsibility to analyze each situation and use every available resource to accomplish a safe docking. Taking advantage of the wind and current, using undercarriage and drogues, "blipping" engines, using crewmen to raise and lower the wing tip floats,

## MOORING TO A BUOY



## FLIGHT OPERATIONS

### 5.8 MOORING TO A BUOY

#### a. GENERAL

Mooring is probably the easiest and safest waterborne operation in a Canso. In general, it consists of merely taxiing up to a buoy in such a way that the crewman can catch the "D" ring of the buoy with a buoy hook. Although this sounds simple, when the buoy is in an awkward position, or near to the shore, it is possible to have a mishap.

#### b. APPROACHING AND MOORING

A buoy should always be approached into wind as slowly as possible. The undercarriage should be up to avoid tangling the nose wheel doors with the mooring cable. For the last few hundred feet the engines may be blipped to further slowdown the aircraft. Both drogues should be streamed prior to the final approach.

On reaching the buoy, the aircraft should be almost at a dead stop, enabling the crewman to reach down and hook the buoy. He then puts a slipline through the "D" ring and secures the aircraft to the buoy form the snubbing post. For temporary mooring this is generally adequate.

For mooring the aircraft to a buoy for a longer period or for overnight, the following procedure should be carried out:

(1) The mooring bridle is unfastened and its retaining lines are attached to the snubbing post. If this is not done, the bridle may slip into the water before being fastened, and because it is attached on the underside of the hull well below the waterline, may be impossible to retrieve without diving.

(2) The buoy mooring pendant is pulled up with the retaining cable or chain (sometimes called "lazy chain") which is found hanging down from the "D" ring on most buoys.

(3) The mooring bridle is attached to the strop of grommet on the end of the mooring pendant by means of a clevis.

(4) The slipline is loosened until the full weight of the aircraft is taken up on the aircraft bridle (sometimes called the "lizard"

(5) This slipline is left attached in order to pull the aircraft up to the buoy when it is desired to slip the buoy.

#### c. SLIPPING A BUOY

When slipping a buoy, the reverse of the previous procedure is used. After releasing the bridle and stowing the aircraft is held on the slip-line until the engines are started.

## FLIGHT OPERATIONS

### **SLIPPING A BUOY** (continued)

Assuming that the above actions have been carried out preparatory to slipping a buoy and that the aircraft is now moored only by the slip-line, the only remaining action is to start the engines and cast off. The procedure varies slightly according to the strength and direction of the wind, or proximity of the shoreline, docks or other obstacles. The pilot should be able to anticipate what the aircraft is going to do immediately the first engine starts and act accordingly. There are several noteworthy points in this respect:

(1) In calm conditions, the aircraft tends to start turning immediately the first engine is started. When this happens one effective method of slipping the buoy is to close haul the buoy along the port bow of the aircraft and start the starboard engine first. The aircraft then swings towards the buoy as it moves forward. As the buoy passes amidships, the fuselage of the aircraft is turning away from it, and by the time the second engine is started the aircraft should be past the buoy, and the line cast off.

(2) When the aircraft is in a confined situation, it is sometimes good practice to lengthen the slip-line and not slip buoy until both engines are running. A Canso can circle a buoy indefinitely with both engines idling. The line should be of such a length that the floats are not likely to collide with the buoy.

(3) In strong winds an aircraft can usually be taxied slightly out of wind on one engine. The procedure is to let out ten or fifteen feet of slip-line and apply right rudder. This causes the aircraft to swing out of the wind slightly. The port engine is then started and the aircraft taxis away on one engine with the buoy passing half way between the hull and the wing tip float. Then it only remains to cast off the single slip-line

(4) When the buoy is closed to a shoreline or dock, it is good practice to first moor the aircraft to a buoy and then work it ashore by the use of lines. The opposite procedure is often effective in working the aircraft away from a dock encumbered by piling and other hazards.

## FLIGHT OPERATIONS

### 5.9 SLIPWAY AND RAMP PROCEDURES

#### a. GENERAL

Before using a slipway or ramp, it is necessary to ensure that it can safely carry the weight of the aircraft. Most slipways in use in Canada were built during the Second World War and have had little or not maintenance since. Some are badly eroded at the sides and can support heavy aircraft only in the center. Others have holes and obstructions at the extreme lower end and are unusable during low tides.

The only satisfactory way to inspect a slipway is visually from the ground at the lowest tide. As much information as possible should be gleaned from local sources concerning its construction and the type of aircraft which have been using it recently.

#### b. APPROACHING A SLIPWAY

If the slipway is safe, the approach should be made as slowly as possible with the wheels down and locked. Plenty of time should be allowed the crewmen to check the undercarriage before the aircraft is committed to the approach.

If the approach is made into wind, drogues are not necessary. If made other than into wind particularly downwind, it may be necessary to stream both drogues in order to maintain control at a low speed. The drogues need not be pulled in until the aircraft is safely up the ramp; they drag harmlessly on the ground. In conditions of severe crosswind, it is sometimes necessary to stream one or two drogues, because if too much drag is put on the one side too much throttle may have to be used to keep straight, cancelling out the slow effect of the drogues as the aircraft approaches the lee of the shore.

The rudder lock should be cracked in order that the rudder may be locked immediately both main wheels are on the slipway. Use of the brakes may be needed to keep the aircraft straight while generous throttle is applied to taxi up the slipway.

#### c. DEPARTING FROM A SLIPWAY

The slipway descent should be negotiated as slowly as possible. Coasting down a slipway fast can often cause damage to the rear of the hull, as the aircraft's nose rises suddenly on hitting the water.

As the aircraft enters the water, it is often difficult to maintain the same course as that held down the center of the slipway, so there is a small chance that one of the aircrafts wheels may go off the side of the slipway. This can be prevented by setting a compass or gyro while the slipway is in plain sight. The tendency of inexperienced pilots on entering the water and before coming "Waterborne", is to veer to the left. The reason for this is not known, but it is suspected that the average pilot has been following the left hand edge of the ramp with his eye, and when that disappears he veers over to the left in order to relocate it.

## FLIGHT OPERATIONS

### DEPARTING FROM A SLIPWAY (continued)

The only way in which a pilot could locate the edge of the slipway would be to run the port wheel off the edge. This is obviously not much of a solution, so the setting of gyros is recommended.

When taxiing down the ramp, the rudders should be left locked, but cracked in order that the rudder pedals may be freed from the moment of the aircraft is afloat.

The undercarriage should not be raised until the pilot is sure that he is, in fact, afloat, and that the wheel wells are free of debris.

To prevent seaweed and other floating debris from becoming lodged in the nose doors, care should be taken to taxi through masses of seaweed after departing from the slipway. When on the approach this is not so important as all debris can be removed from the nose wheel doors when the aircraft is out of the water.

If the aircraft has been stopped after coming up a slipway, a complete external examination should be carried out before re-entering the water. More than one Canso has been lost on entering the water owing to the tunnel hatch being unlocked.

## ANCHORING

## C-FUAW ANCHOR SYSTEM

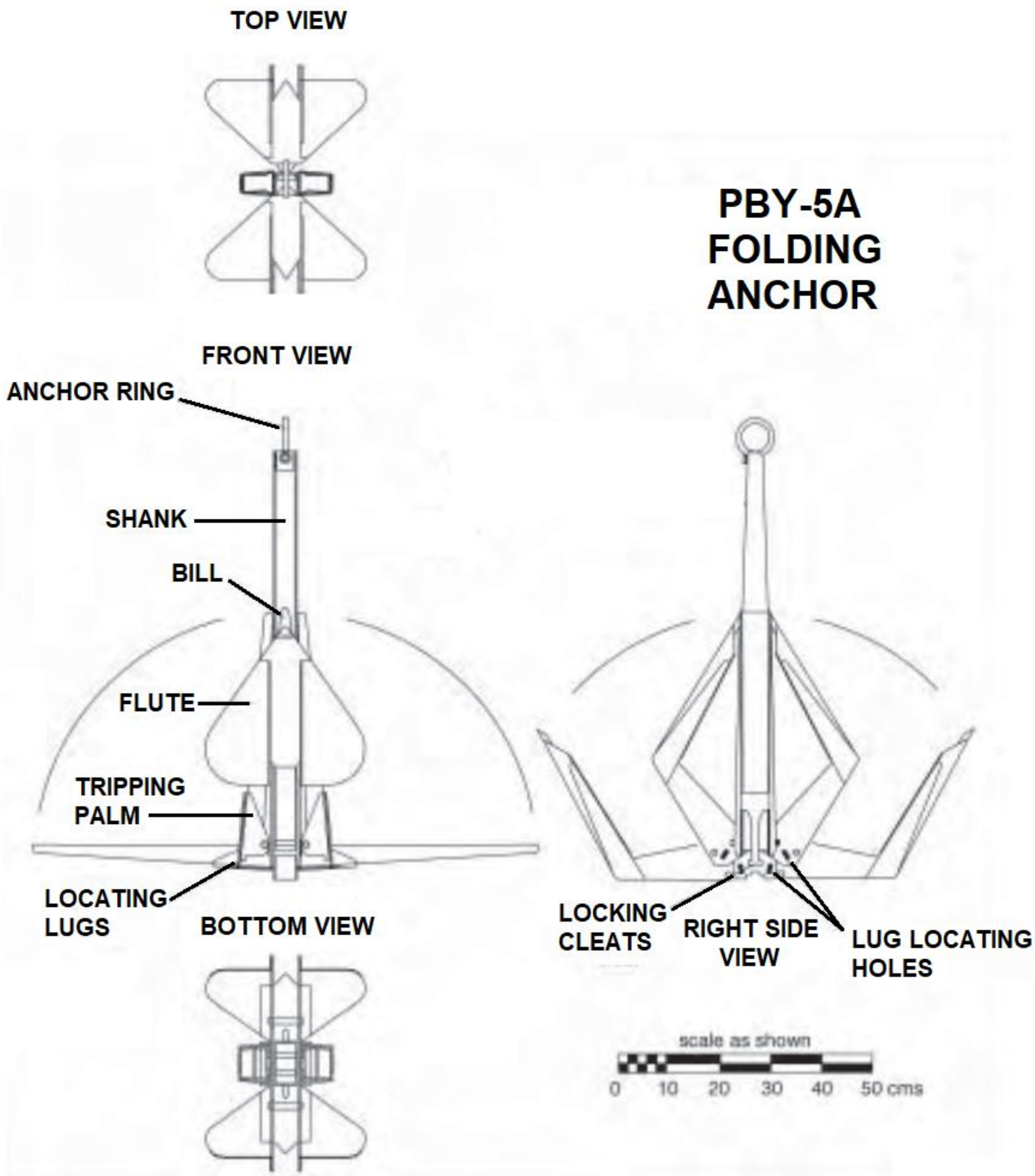
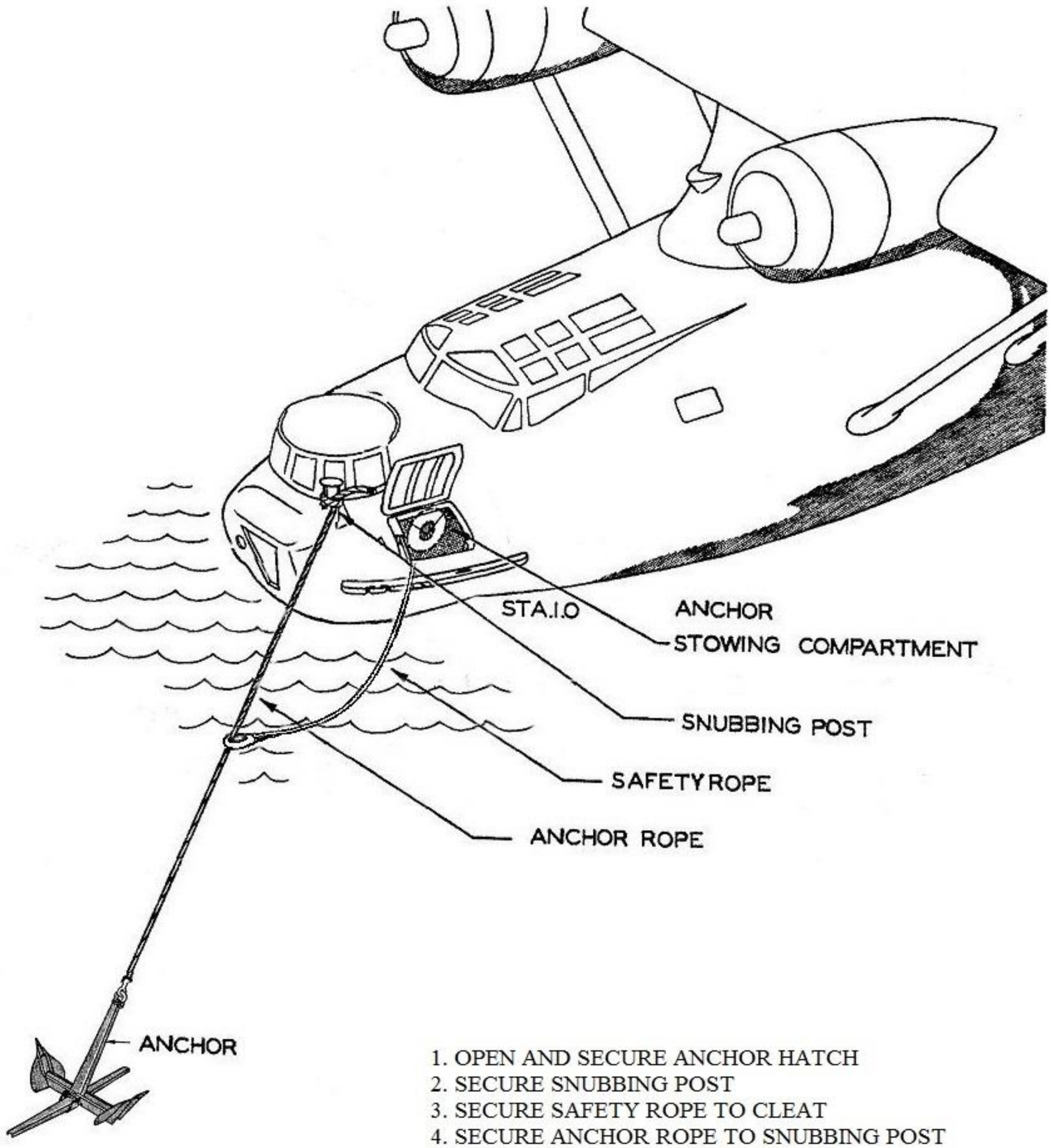



Figure 73




1. OPEN AND SECURE ANCHOR HATCH
2. SECURE SNUBBING POST
3. SECURE SAFETY ROPE TO CLEAT
4. SECURE ANCHOR ROPE TO SNUBBING POST
5. DROP ANCHOR IN WATER AND SET

Figure 74

# FLIGHT OPERATIONS

## 5.10 ANCHORING

### a. GENERAL

The Canso anchor, a folding one made of aluminum alloy, weighs approximately 30 pounds. It is, of necessity, light and should not be used if other suitable moorings are available. The anchor is stowed in the port side of the nose and access to it may be gained from outside the aircraft. The anchor winch is operated from inside the aircraft; at least two crewmen are required; one outside with the anchor and the other inside to operate the winch.

The anchor cable is 150 feet in length, wound on a drum inside the aircraft. If this drum is allowed to spin freely during an anchoring, the cable is almost sure to become fouled. Care must be taken inside to prevent fouling as it may take hours to untangle.

When selecting an anchorage, the following factors should be considered.

(1) The shelter afforded

(2) The swinging space available

(3) The strength of the wind and tide

(4) The distance from the lee shore

(5) The depth of the water and range of tide

(6) The type of holding ground (bottom) and

(7) The presence of mooring or telegraph cables on the bottom

### b. LAYING AN ANCHOR

The aircraft is taxied slowly up to the selected anchorage. The anchor is then let go, and the cable equal to at least the and, if possible, five times the depth of the water is paid out while the aircraft is drifting astern. As the anchor holds, beam bearing should be taken so that dragging can be immediately detected.

In calm weather when the aircraft does not give sufficient pull for the anchor to be buried, the aircraft is taxied slowly downwind and the aircraft is brought to a stop by the now well entrenched. The engines can then be cut and the aircraft drifts round into wind and lies to the anchor. Care must be taken to carry out this manoeuvre at speed, otherwise the cable or anchor may be strained or broken.

### c. WEIGHING ANCHOR

When weighing anchor, the cable is winched in until it is vertical. The engines may be required to assist in this process; if not, they should now be started. After a turn of the cable around the bollard the aircraft is taxied forward, this breaks out the anchor which can then be winched up and stowed.

## FLIGHT OPERATIONS

### d. PREVENTING AN ANCHOR FROM DRAGGING

When an anchor drags, the first thing to do is to let out more cable, whilst doing this, it is advisable to allow the aircraft to drift back quickly and then make fast the cable so that it is brought to suddenly. This helps to bury the fluke, besides making the pull more horizontal. If this has no effect, sometimes a heavy weight attached well down the cable may act as a shock absorber in rough weather and may also help to make the cable lie horizontally nearer the sea bed.

If the aircraft is going to be anchored for any length of time, or if the water is rough, the anchor cable should be attached to the bridle by means of the clamp. The cable should be paid out from the drum until all tension is off the drum and the aircraft weight is on the bridle. Under certain circumstances, a few turns around a bollard may be made to create the same effect; but this is harder on the aircraft since the bollards are not designed to take as much strain as the bridle and mooring ring.

# FLIGHT OPERATIONS

## OPERATING FROM RIVERS


Scott Bowker

# FLIGHT OPERATIONS

## 5.11 OPERATING FROM RIVERS

### a. GENERAL

Taking off, alighting and operating on rivers are operations demanding skill. Rivers are generally muddy and contain shifting sandbars; since the pilot is unable to distinguish the shallow water from the air, he is taking a chance on landing unless he is absolutely sure of the depth of the water.

### b. EFFECT OF CURRENT AND WIND

Currents are often strong and create an additional problem for a pilot attempting to moor dock, beach, or even taxi. A current has a much greater effect on an aircraft than a wind of the same speed. Therefore, during light wind conditions, it is an advantage to take off down current. Taking off down a 10 kts current gives an advantage of 20 kts over an up current take-off. Similarly, landing against the current give a shorter landing run.

An approach to a dock, beach or mooring should always be made up current except when there are exceptionally strong winds. If in doubt, the pilot should taxi the parallel to the back in both directions to test for himself which direction gives the slowest approach and the greatest control.

Crosswind conditions are common and pilots should be proficient in crosswind techniques before operating from rivers. After take-off, the river should be followed until sufficient height has been gained. Flying low over the bush should be avoided as turbulence is often severe.

### c. OBSTRUCTION AND HAZARDS

During springtime, extra precautions must be taken because of floating debris. An area of debris can be found around the bend of a river because the current usually sweeps the debris over to the far bank. Similarly, deep water is often found on the outside of a bend in the river where the backs are steeply cut, rather than on the inside of the bend where the current is lighter and where sediment is dropped o of the water. Steep banks usually indicate deep water, whereas wide beaches quite often indicate shallow water and shifting sandbars.Rivers often have power lines crossing them. This constitutes probably the biggest single hazard in river operations. A careful watch should be kept for any type of construction on either river bank. The cables are always invisible until it is too late to avoid them, but the pylons and towers are usually easy to see. At the first sight of anything resembling a tower, the pilot should suspect a cable, even if he cannot see one, and pull up. Muddy bottoms often hamper beach operations. If it is suspected that the bottom is muddy, the nose wheel door should be closed and locked, otherwise it becomes full of mud and debris and becomes impossible to close prior to take-off.

APPENDIX “C”

## FLOAT OPERATION

The wing tip floats are electrically operated normally, but there is an emergency hand crank in the flight engineers position. A two speed gear system is incorporated for manually raising and lowering the floats. The float motor causes a heavy drain on the battery so both engine generators must be charging fully before any attempt is made to raise or lower the floats.

If the floats have been lowered on land to tie down overnight, they may be hand cranked up. Or both throttles may be opened up enough for the generators to cut in (1500 rpm) and the floats rise normally. They are to be raised before take-off on land; with floats down the airspeed is reduced by approximately 5 kts and aileron control is appreciably reduced.

APPENDIX “D”

## 5.12 TAXIING

### a. TAXIING ON LAND

(1) The maximum turning angle of the nose wheel is 30 degrees. The scissors which limit its movement could be broken by the stress of a sharp turn. Another reason for avoiding this manoeuvre is that on rough ground or loose gravel it can cause creeping of the nose wheel tires, resulting in the shearing off of the valve stem.

(2) The aircraft should be in forward motion and the nose wheel castoring before any attempt is made to turn, and no attempt should be made to force a turn against the lie on the nose wheel. It is therefore advisable, when leaving a parking position, to test the brakes for positive action, and then to make an desired turn. Turns should never be made on a locked inside main wheel.

(3) Taxiing should be done with a minimum of brake. Care must be exercised when applying brakes otherwise they may overheat, or produce a lurching movement throwing an excessive load on the nose wheel tire. Dual brakes are provided, but because of the differential linkage system only one pilot can apply brakes at one time.

(4) Use of the rudder lock in taxiing is left to the pilot’s discretion. If fairly calm conditions exist, the aircraft can be easily controlled by rudder and engines; however, in moderate to strong wind conditions the rudder should be locked.

### b. TAXIING ON WATER

(1) Taxiing should be kept to a minimum

(2) Care must be taken to avoid overheating the engines, and to prevent water spray damage to engines and propellers.

(3) The taxiing speed should be kept low without prolonged idling of the engines. This is achieved by keeping the nose as high as possible and by using drogues to the fullest reasonable extent.

(4) The undercarriage may be used for its drogue effect, particularly in rough water handling. Before it is lowered taxi speed must be reduced to the lowest possible to allow the nose wheel to lock down. The undercarriage must be down and locked before grounding.

(5) At all times care must be taken to prevent damage to the undercarriage or nose wheel doors when down in the water.

# APPENDIX 1

## WATER BOMBING SYSTEM

# APPENDIX 1

## 5.13 BOMBING SYSTEM

### a. GENERAL

The bombing system is a Field Aviation Company modification. The system is hydraulically operated from the aircraft hydraulic system using the 5" accumulator pressure supply.

The hydraulic units of the system are electrically controlled using the aircraft 24 volt D.C. system.

The Field Aviation Aerial Tanker Operation Flight Manual Amendment has proved to be a reasonable guide for the operation of this system, one major exception is that lowering of the probe for pick-up prior to touch down has been discontinued.

The above mentioned Flight Manual Amendment is included in this manual as APPENDIX 1, to this Section 15, Bombing System.

**APPENDIX 1**

DATE: MAY 15th, 1964 REVISION 1

REPORT NO.: FACL 4562A

AERIAL TANKER OPERATION
FLIGHT MANUAL AMENDMENT

b. **NORMAL OPERATION**

Flying and floatation characteristics of the aircraft have not been changed.

The aircraft may be used for passenger and freight carrying with the same limitations as in the unmodified aircraft. However, the following additional must be carried out:

1) Water master switch must be OFF
2) Water hydraulic isolation valve must be OFF
3) Stiff leg safety bracket must be installed
4) Probe safety bracket must be installed

The cockpit has placards with the above.

c. **FIRE FIGHTING OPERATIONS**

Note: When being operated as a fire fighter, the aircraft is restricted to only that crew necessary for the operation. Flying and floatation characteristics of the aircraft have not been changed.

d. **Before Starting:**

1) Stiff leg safety bracket is removed
2) Probe safety bracket is removed

e. **Pre-Flight Check (Engines Idling)**

1) Select ON tanker master and isolation valve
2) Ensure 1000 PSI hydraulic pressure
3) Select ON arming switch - observe Amber light
4) Throttle back starboard engine to slow IDLE
5) Dump both tanks, and release Dump button
6) Observe hydraulic pressure deflate, then as doors close, observe pressure build up. Observe exact pressure of door latching. The gauge will fluctuate as each door latches, and the latching sound can be heard. Latching pressure must be between 500 and 700 PSI. It is not necessary that both doors latch at the same pressure, as long as each is within the prescribed range

**APPENDIX 1**

f. **Pre-Flight Check (Engines Idling)** (continued)

7) Operate probe. Observe lights

8) Operate emergency dump lever. Reset stiff legs and close doors (See Section 5 for resetting stiff leg)

9) All switches and valves OFF. Observe door closing lights Green

g. **Water Pick-up by Probe**

**Action** Upon approach to the pick-up point:

1) Water Master Switch is turned ON

2) Water hydraulic isolation valve is turned ON

3) Dump arming switch is OFF

**Check**

1) Door indicator light and jack position lights (4 lights) are GREEN

2) Probe light is GREEN

3) Amber arming lights on control column are OFF

4) Visual check of door indicators in tank windows

5) Ensure 1000 PSI hydraulic pressure

Note**:** probe may be lowered after touchdown

h. **Probe light goes from Green to Red** (when lowered)

**Action**

1) Carry out normal approach and touchdown but with wing floats up

2) Immediately after touchdown, take-off power should be supplied. If probe is lowered after touchdown it should be timed so that power surge balances probe drag

3) Except in heavy chop or swell, speed should not be allowed to fall below 65 knots and preferably 70 knots. This can be achieved by holding the aircraft in a high nose up attitude after probe lowering. This attitude must be decreased as waves become heavier, to prevent incipient take-off. Loading time will be 12 to 17 seconds depending on wind and increases as wind velocity increases but

## APPENDIX 1

**Probe light goes from Green to Red** (when lowered)

loading distance remains constant at about 1600 feet. Full tanks can be observed by the co-pilot's visual check through the tank from windows

4) Retract probe. Observe light from Red to Green
5) If speed has been maintained at or near 70 knots, the surge that accompanies probe retraction, combined with rearward pressure on the stick, is sufficient to release the aircraft in an immediate, clean, take-off
6) After take-off is secure, arming switch should be turned on so that in case of emergency ( high shoreline, engine failure, etc.), and immediate dump may be achieved. Note Amber light.

i. **Load Dumping**: Upon approach to dump point:

**Check**

1) Water master switch is ON
2) Door lights and closing jack lights (4 Lights) are GREEN
3) Hydraulic isolation valve is ON
4) Dump arming switch is ON and lights are Amber

**Action**

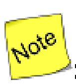
1) Select climbing R.P.M. (if necessary for pull up)
2) Select for single or double tank dump

The best speed and altitude is 100 feet at 95 knots. This, of course, will vary with terrain, type of fire, tree height, etc. An approximate rule for aiming is that at this speed and altitude, the load is dropped just after the target passes out of view under the nose. Wind, however, affects this as well as speed and altitude. On hillsides, load should be dumped higher up the slope than would appear to be correct for hitting the target.

j. **Double Tank Dump**

**Action**

1) Dump by depressing either dump button




**:** Initially a pitch up will be experienced followed by settlingout to a slight nose down tendency. The pitch up can, with a small amount of practice, be overcome by short duration "push" on the control column at the point of door latching.

2) Release dump button (doors will close)

**APPENDIX 1**

k. **Single Tank Dump**

1) Dumps spaced more than 15 seconds apart

**Action**

1) Select "Single" on selector switch on console
2) Dump by depressing either dump button (R.H. tank dumps)
3) Release dump button (R.H. tank door closes)
4) After door closes and jacks retract (four Green lights) select "Double" on selector switch on console and carry on as in A.

l. **Dumps spaced less than 15 seconds apart**

**Action**

1) Select "Single" as above
2) Dump by depressing and holding either dump button (R.H. tank dumps)
3) Select "Double" as above (L.H. Tank dumps)
4) Release dump button (both tank doors close)

**:** A one second separation will provide continuous coverage

**Check**- Applies to A or B

1) Door warning light will go to Green approximately (4 sec) four seconds after release of dump button. Closing jack lights will go to Green approximately four seconds (4 sec.) after door lights
2) Arming switch OFF - Amber light OUT

m. **Shut Down**

Doors may be left open or closed. If closed, all switches and isolation valve are turned OFF.
If doors are to be left open, they may be dumped normally but dump button must be held until isolation valve or tanker master switch is turned OFF.

**WARNINGS!! - THESE WARNINGS ARE VITAL FOR SAFETY**

1) Loading ***must not*** take place unless ***both*** door indicator lights are Green, and ***both*** door closing lights are Green

2) Under all conditions, arming switch must be OFF and Amber lights OUT before approach or touchdown on water

**APPENDIX 1**

**WARNINGS!!** (continued)

3) Under all conditions, before approach and touchdown on water, the hydraulic isolation valve must be ON (excepting WHEN THE STIFF LEG SAFETY BRACKET IS IN PLACE). While this will normally be on for loading, it must also be on for any water landing, so that the latching jacks will be energized in the latched position.

## EMERGENCY PROCEDURES

### 2.29.1 Electrical Failure

(1) **Aircraft Loaded - Doors Closed**

Nothing alters upon electrical failure. Load may be dumped by pulling the Red emergency handle which buckles both stiff legs and in turn removes the latches from the vicinity of their respective catches.

The Red emergency handle is located just above the floor on the right hand side of the pilot seat.

Doors may be closed by depressing the manual controls on hydraulic selectors on No. 4 bulkhead.

(2) **Doors Open**

Nothing alters upon electrical failure.

Doors may be closed as above. Latches may be physically checked by a crew member (as in the case of undercarriage lowering).

(3) **Probe Lowered**

Probe retracts upon electrical failure.

### 2.29.2 Hydraulic Failure

(1) **Aircraft Loaded - Doors Closed**

Nothing alters upon failure as latching jacks are spring loaded into latch position.

Load may be released by pulling the Red emergency handle which buckles both stiff legs and in turn removes the latches from the vicinity of their respective catches.

(2) **Doors Open**

If a water landing is imminent, doors may be closed by manual tool provided, after manually re-setting the stiff legs. If aland landing is imminent, doors may be left open.

(3) **Probe**

Probe will remain in the position it occupies at point of failure.

## APPENDIX 1

### EMERGENCY PROCEDURES (continued)

#### 2.29.3 Circuitry Failure

Circuitry failure will cause partial or full failure. Procedure should be as in electrical failure, excepting that in failure of the door closing relay, automatic closing is relinquished, and doors may be closed by depressing the emergency close button on the yoke, until the door warning lights turn Green.

d. **Failure During Cycling**

All cycles will either cease, return to the state before the cycle started, or continue to the cycle completion. Emergency measures as described above still apply.

e. **Closing Jack Failure**

It is important to note that the closing jack is not involved in loading or dumping. Any failure here ***must*** be noted before loading, and loading ***must not*** take place.

f. **MECHANICAL EMERGENCY RELEASE (RED HANDLE)**

When testing this system, under conditions of no failure and power on, stiff legs may be reset by arming and depressing the dump switch. This will hold the door closing jacks retracted while resetting takes place. Upon release of the button, doors will close.

### FIRE FIGHTING TACTICS

a. It has been observed that the effectiveness of Aerial Tankers increases much more than proportionately to the rate of delivery. This means then the following:

   (1) Two aircraft working on one fire are much more than twice as effective as one.

   (2) If one aircraft increases its rate by a certain percentage, its effectiveness will increase by much more than that percentage.

   (3) Fifteen loads delivered in one hour will produce much more effect than fifteen loads delivered in one-hour-and-one-half.

b. With safety as a first consideration, the operation should be set up such that the highest possible rate of delivery is achieved.

c. Seconds wasted on the water by loss of speed not only consume more time and more lake run, but also produces more wear and tear on engines and airframe, not to mention the pilots.

d. Downwind and crosswind loading runs are permissible as a means of increasing delivery rate, but should be used only when they satisfy all considerations of safety.

# PBY CANSO C-FUAW

C-FUAW Probe and Water Tank

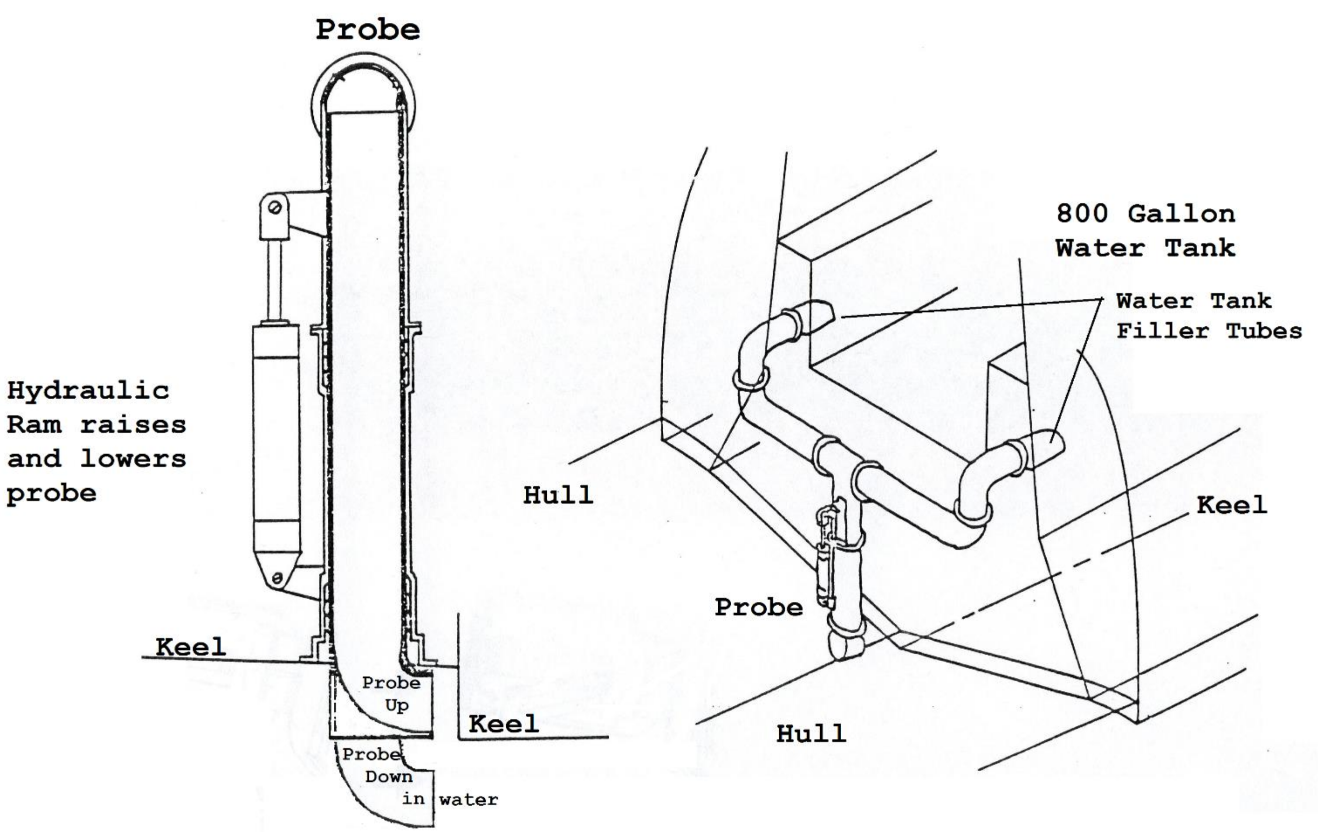



Figure 75

## Water Tank and Drop Door Mechanism

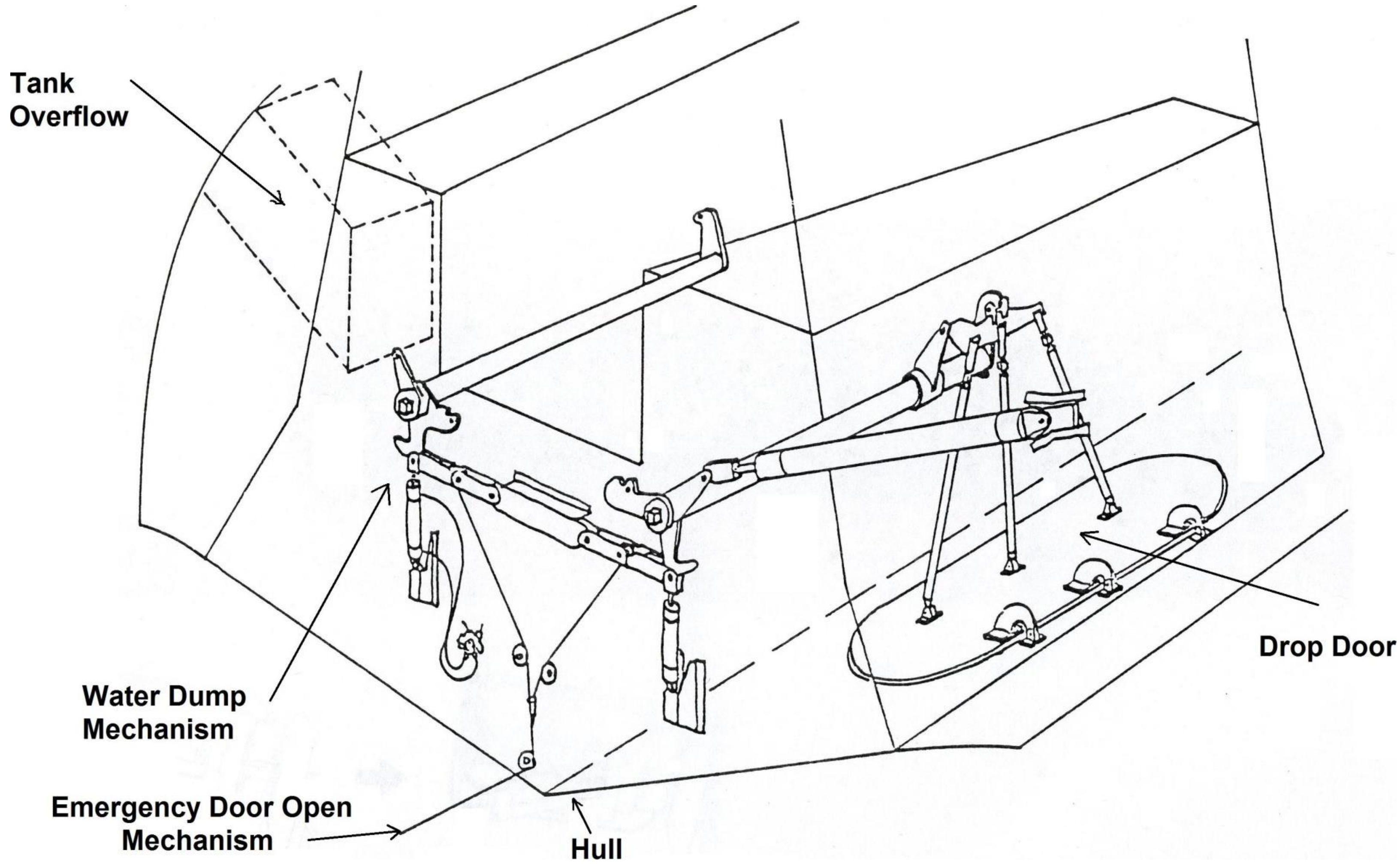



Figure 76

## AIRWORTHINESS DIRECTIVES/SERVICE BULLETINS

CANSO PBY-5A MINISTRY OF TRANSPORT AIRWORTHINESS DIRECTIVES

AWD 67 - 2 Inspect Water Door Latches Every 1000 drops or 12 mos.

AWD 68 - 3 Inspect Bomb Door Turnbuckles Every 2500 cycles

N - AME AO 9/73 Inspect Wing Splice Every 400 hours

A D CF-8-15 Hamilton Standard Hydromatic Propellers

FIELD SERVICE BULLETINS

FIELD at 67 - 1 Same as AWD 67 – 2 Every 1000 drops or 12 months

FIELD at 68 - 3 Same as AWD 68 - 3 2000 then Every 3000 cycles

TRANSPORT CANADA AIR — TRANSPORTS CANADA AIR — N - AME - AO NO. 9/73 — JANUARY 25, 1973

NOTICE TO

AIRCRAFT MAINTENANCE ENGINEERS AND AIRCRAFT OWNERS

CONSOLIDATED VULTEE, CANADIAN VICKERS,

BOEING OF CANADA MODELS PBY-5A and 28-SACF

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There has been a report of the discovery in a single aircraft of a number of failed lower surface wing joint Z-stringer attachment brackets, Part Number 28W1057 and 28W1058. The failures are attributed to inadequate torque on the associated tension bolts. This condition could be the result either of improper assembly or of loosening in service.

In view of the failures, it is recommended that the following be accomplished at or before the next 120 hour check and subsequently during each 400-hour inspection:

a) inspect the brackets thoroughly for corrosion, cracking, fretting or fracture;

b) Check for indications that the bolts are loose. Where any doubt exists, the bolts should be removed, inspected and re-installed, torquing to the correct values.
Allowable bolt torques are specified in the PBY-5A Maintenance Manual AN-01-5MA-2, Page 714, or alternatively in F.A.A. Advisory Circular AC 43.13-1, Figure 5-2.

Failed, cracked or worn parts should be replaced with airworthy ones of the same part number, or equivalent parts approved by the Chief Aeronautical Engineer, Ministry of Transport.

E. P. BRIDGLAND,

CHIEF AERONAUTICAL ENGINEER,
for DIRECTOR GENERAL, CIVIL AERONAUTICS.

COPY of ORIGINAL N-AME-AO

## SUPPLEMENT 1

## CANSO PBY-5A EQUIPPED WITH AN AIRSPRAY FOAM INJECTION SYSTEM

This supplement is applicable when the aircraft is modified by the installation of an approved, Air Spray (1967) Ltd. foam injection system.

The basic Flight Manual, and supplements, remain applicable except as changed by this document.

a. **LIMITATIONS** - The following limitations are considered mandatory.
- Only non-hazardous, non-flammable fluids are to be used in the foam system.

b. **NORMAL PROCEDURES**

(1) Before engine start

(a) Ensure system is off

(b) Ensure loading nozzle cap is installed

(c) Ground loading valve (black handle) is closed

(d) Ensure injection valve (red handle) is open

For weight and balance purposes the foam tank contents are at 330.0 inches aft of datum

(2) To operate the foam system en route to the fire

(a) Select injection time based on the ratio chart located on the right hand co-pilots panel.

(b) Arm the system (switch to arm)

(c) Selection switch to inject

(d) Press the inject button to inject the desired amount of foam concentrate.

(e) Crew to monitor water/foam level as needed

(f) Turn system off when fire action is completed

Note: The foam tank is equipped with a sight gauge for loading and an inject pressure indicating light. The system should not be operated when the Inject Pressure light is on, since damage can result to the pump.

c. **EMERGENCY PROCEDURES**

(1) In the event of system malfunction switch system off
(2) System circuit breakers are located on the Main Distribution panel (forward of water tank), and may be pulled as the need arises. This requires a flight crew member to leave the cockpit
(3) The foam tank can be unloaded by injecting the concentrate into the water tanks and dumping at the discretion of the flight crew. Unloading a full concentrate tank takes about 8 minutes by this method.
(4) PERFORMANCE – No Change

## OPERATION OF SYSTEM

a. **Two methods of loading are -**

(1) **Ground. R**emove quick disconnect cap from L/H side of A/C, connect ground loading hose. Once inside aircraft the forward RED injection valve is closed, and the rear BLACK valve is opened. The external ground loading switch can be operated from rear exit door while monitoring loading level. Return valves to normal, disconnect loading hose, re-install cap to quick disconnect.

(2) **Aircraft.** Remove quick disconnect cap from L/H side of A/C and connect ground loading standpipe. Once inside aircraft the forward RED injecting valve is closed with the BLACK ground loading valve also in the closed position. Start the A.P.U. and move loading switch to the load position. Stop pump when barrel is empty. Loading can also be done from the cockpit by arming system, set switch to load, select desired time, and press inject button. Loading can be stopped at any time by dis-arming system. The desired method is to load by selecting at the rear station.

*Caution* **DO NOT RUN PUMP DRY THIS WILL SHORTEN LIFE OF PUMP**

**After loading**, return RED injection valve to normal (open), and disconnect loading hose, and re-install cap to quick disconnect.

a. **TO UNLOAD** - Remove quick disconnect cap from L/H side and connect ground load stand pipe, set in collector container. Once inside A/C close RED injection valve, open BLACK loading valve allowing fluid to gravity drain to same level of loading hose and tank level. Unloading using electrical system can also be accomplished by two methods.

(1) **REAR UNLOADING STATION** - Close RED injection valve, BLACK loading valve closed, and start A.P.U. move switch to unload and stop when tank is empty.

(2) **TIMER SYSTEM** - Close RED injection valve, BLACK loading valve closed, start A.P.U.. Arm system, set desired time, select inject, and press inject button. System can be stopped at any time by de-arming. The most desired method is to operate from the rear station as to monitor the level to prevent pump from running dry.

*Caution* **DO NOT RUN PUMP DRY THIS WILL SHORTEN LIFE OF PUMP**

**After unloading**, return valves to normal and disconnect loading hose and reinstall cap to quick disconnect.

**TESTING** - Can be accomplished with fluid in injecting valve, open BLACK loading valve, select inject, set time and press inject circulate in the tank.