AP 1517B-PN

SWORDFISH
Mk II

AIRCREW MANUAL

1993 Edition

Ministry of Defence
July 1993

AP 1517B - PN
(1993 Edition)

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Insert this 1993 Edition into a standard, blue anonymous A5 binder.

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July 1993

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SWORDFISH II

AIRCREW MANUAL

BY ORDER OF THE DEFENCE COUNCIL

Prepared by the Royal Navy Historic Flight

NOTES TO USERS

1. This Manual was re-written in 1993 to reflect the operating profile of the Royal Navy Historic Flight Swordfish 2 aircraft in the display flying role. The information is sparse in comparison with modern types and relies heavily on pilots' general experience and a good grounding in piston engines.

2. This Manual is divided into four parts: Description, Limitations, Handling, and Emergencies. Part I gives only a brief description of the controls with which the pilot should be acquainted. Each page is identified by a Part and Page reference.

3. The limitations quoted in Part 2 are mandatory and are not to be exceeded except in an emergency. Instructions containing the words 'is to' or 'are to' are also mandatory.

4. This Manual aims to provide the best operating instructions and advice currently available. Although it provides guidance for most eventualities, it is not a substitute for sound judgement and good airmanship; moreover, it assumes an adequate knowledge of the pertinent volumes of AP3456 (series) - Flying. Additional information is detailed in Historic Flight Orders, signals or SFIs as appropriate and necessary. Furthermore, circumstances might require aircrew to depart from or modify the prescribed procedures and drills. Consequently, the Manual should not be regarded as a document which is to be adhered to inflexibly at all times other than as explained in para 3.

5. Amendment lists are issued as necessary and each amendment list instruction sheet includes a list of modifications covered by the amendment. New or amended matter of importance is indicated by ◆ ..... ◆ for insertions and ◆◆ for deletions. Sheets issued by amendment bear the AL number at the bottom of the odd-numbered page and any symbols on either page forming a sheet refer to this amendment list. However, when a new chapter is issued with an amendment list, or an existing chapter is completely revised, this fact is indicated within the heading of the chapter and the symbols do not appear on the pages.

6. The following conventions are observed throughout this Manual:

   a. The actual markings on controls are indicated in the text by capital letters.

   b. Unless otherwise stated, all airspeeds, temperatures, pressures and altitudes quoted are indicated values.

   c. **WARNINGS** are inserted only where the serious consequences of not following a certain procedure might otherwise be overlooked.

   d. Information which requires emphasis is printed in italics.

   e. Notes are inserted to clarify the reason for a procedure or to give information which, while not essential to the understanding of the subject, is useful.

   f. Cross references in the text refer to the same Part, unless otherwise stated.

7. Modification numbers are only referred to in the text when it is necessary to differentiate between pre- and post-Mod states. A list of modifications mentioned in the text is included in the preliminary pages with a cross reference to the location in the text of the modification details.

IMPORTANT

Comments and suggestions should be forwarded to the Commanding Officer, Royal Navy Historic Flight, Royal Naval Air Station Yeovilton, Ilchester, Somerset, BA22 8HT.

AMENDMENT RECORD SHEET

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1			
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LIST OF PAGES

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INTRODUCTION

1. The Fairey Swordfish II is a braced biplane of tubular space frame construction, generally covered with doped fabric. It is powered by a 750 HP Bristol Pegasus 30, 9-cylinder air cooled radial engine driving a fixed pitch 3-blade metal propeller. The engine has a single stage centrifugal supercharger feeding a Claudel Hobson carburettor and two separate magneto ignition systems, incorporating booster coils for starting. The aircraft has a conventional landing gear with high absorption oleos and fully castoring tailwheel. The fuselage houses three cockpits, one each for Pilot, Observer and Gunner. Two people can easily be carried in each of the rear cockpits.

LEADING PARTICULARS

Principal Dimensions

Refer to Fig 1.

Power Plant

Engine change unit	...	Bristol Pegasus 30
Type	...	9-cylinder, air-cooled radial
Propeller ...	...	Fixed pitch, metal, 3-bladed
Engine oil capacity	...	11·75 gallons
Engine oil type	...	OMD-370, Nato Code O-128 (alternative OMD-250, Nato Code O-125)
Fuel	...	Avgas 100LL, grade 100/130, Nato Code F-18

Landing Gear

Type	...	Fixed conventional with high absorption oleos and a fully castoring tailwheel

Electrical System

Generator ...	...	28-volt DC, Type HX2
Battery ...	...	24-volt SAFT or SLAB

Radios

UHF	...	...	PTR 1751
VHF	...	...	AD 120

LIST OF MODIFICATIONS MENTIONED IN THE TEXT

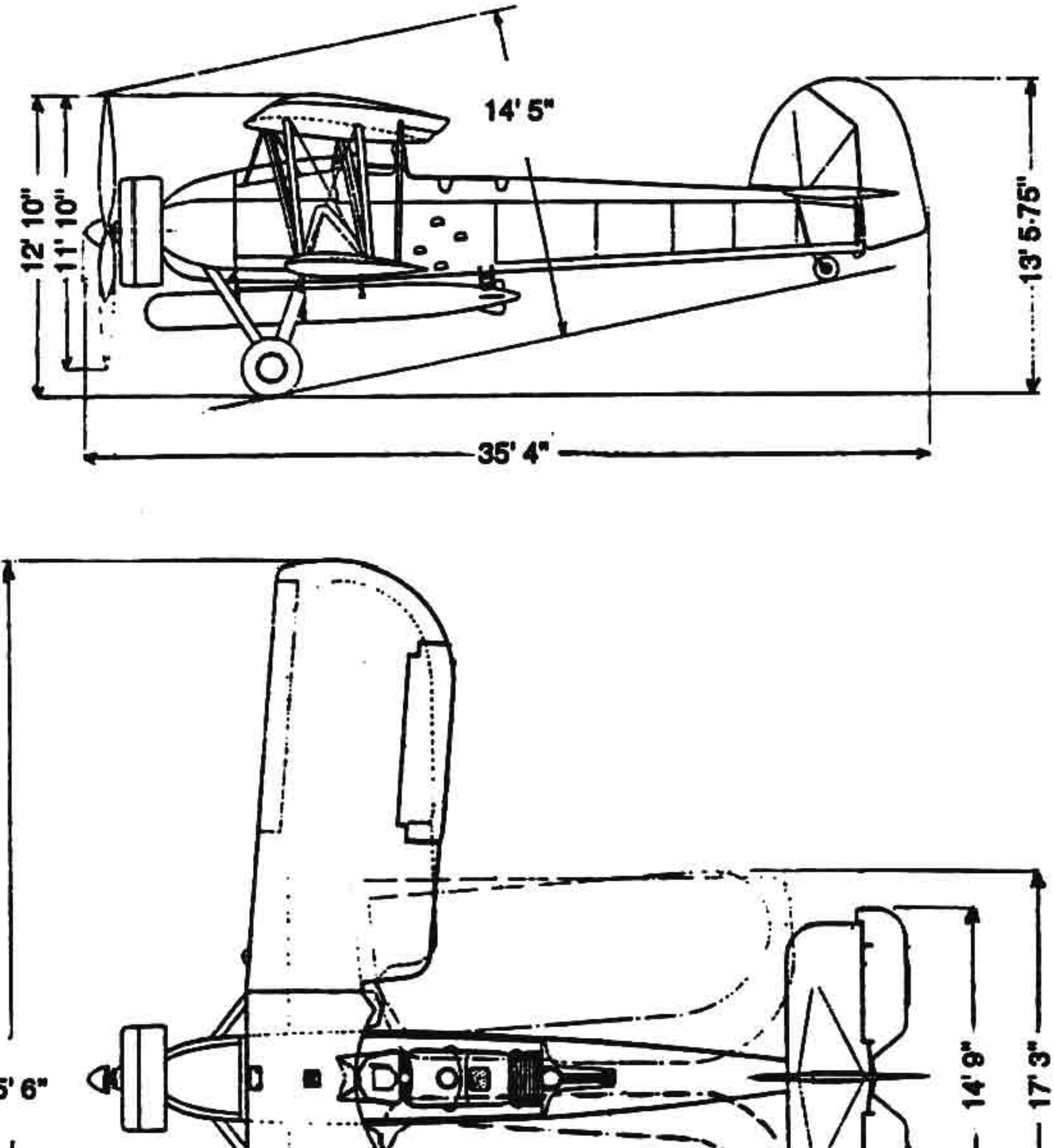
Mod No	*Brief Description*	*Location in the Text*	
		Part	*Para*

LIST OF ASSOCIATED AIR PUBLICATIONS

AP 1517A - 5C, G, K, L	(Basic Servicing Schedule)
AP 1517A - 5B1	(Flight Servicing Schedule)
AP 1517A - 5M	(Draft Flight Test Schedule)

LIST OF ABBREVIATIONS USED IN THE TEXT

AGL	Above ground level
C	Celsius
FRC	Flight Reference Cards
MHz	Megahertz
PSI	Pounds per square inch
RPM	Revolutions per minute
UHF	Ultra high frequency
VHF	Very high frequency



Preliminaries Fig 1 General Arrangement

PART 1

DESCRIPTION

PART 1

DESCRIPTION

Contents

Note: In the following description controls, switches and indicators are in the front cockpit unless otherwise stated.

Fuel System

1. *Fuel Tanks*. Fuel is carried in two tanks behind the engine. A main tank contains 155 gallons and a gravity tank contains 12·5 gallons.

2. *Gauges*. Two direct reading float-operated gauges are fitted, one for each tank. The main tank is calibrated in increments of 10 gallons; the gravity tank is labelled E/¼/½/¾/F. The gauges may be viewed through a hole in the top centre of the instrument panel when lit by their own lamp the switch for which is labelled PETROL GAUGE SWITCH and is on top of the armament panel.

3. *Fuel Cock.* A four-way control marked OFF/NORMAL BOTH/GRAVITY ONLY/MAIN ONLY is on the right of the pilot's seat.

a. *NORMAL BOTH.* At NORMAL BOTH the cock connects the main tank to the carburettor via the engine-driven pump and the gravity tank directly to the carburettor. Any surplus from the fuel pump, not used in the carburettor is returned to the gravity tank. The overflow from the gravity tank, when full, discharges back to the main tank. If the engine pump fails, the gravity tank feeds directly to the carburettor. The gravity tank can then be refuelled from the main tank by the hand pump.

b. *GRAVITY ONLY.* The gravity tank supplies the fuel pump, as well as a direct line to the carburettor, and the main tank supply is cut off.

c. *MAIN ONLY.* The main tank supplies the fuel pump and the gravity tank is cut off.

4. *Engine-driven Pump.* An engine-driven fuel pump supplies the carburettor from whichever tank is selected, as explained above.

5. *Warning Light.* A warning light is on the instrument panel. When the engine-driven pump is supplying normal pressure the light is out. When pressure falls the warning light comes on.

6. *Priming Pump.* On the lower port side of the instrument panel is a Ki-gas type priming pump. After it has been used for starting ensure that it is screwed fully in.

Engine Controls

7. *Throttle and Mixture Controls.* The throttle and mixture levers are on the cockpit left sidewall, and incorporate their own friction screws. The throttle operates in the conventional sense. The mixture is marked RICH/ALTITUDE/ WEAK. RICH is to be used for take-off as it also operates a boost override device. ALTITUDE should be used for cruising. WEAK is blanked off and should not be used.

8. *Boost Control Unit.* A capsule-operated boost control unit is fitted to the carburettor to maintain boost pressure with increasing altitude. Additionally, in

the ALTITUDE setting, it limits the maximum boost achievable to +0·5 PSI. In the RICH setting it limits maximum boost to +2 PSI.

Note: At high airspeeds it is possible to exceed maximum permissible RPM without achieving maximum boost.

9. *Carburettor Intake Heat.* A control on the left under the instrument panel, labelled AIR INTAKE SHUTTER - TO OPEN PULL AND TURN, selects hot or cold air to be drawn into the supercharger.

10. *Emergency Carburettor De-icer.* A brass carburettor de-icer pump is on the starboard cockpit shelf. It allows AL-11 de-icing fluid to flow slowly into the intake area. It should be selected on in an icing environment and its brass plunger operated slowly up and down to pump fluid.

11. *Slow Running Cutout.* A control on the lower left side of the instrument panel marked FUEL CUT-OFF, shuts off the fuel supply to the carburettor when pulled.

12. *Inertia Starter.* A ring pull on the left side under the instrument panel clutches a highly geared, hand-powered, 7-inch flywheel to the engine to turn it sufficiently to start it.

13. *Ignition Switches.* Two switches, labelled MAGNETO NO 1, NO 2 - ON/OFF control the ignition systems by earthing out the circuit when selected OFF.

14. *Booster Coils.* Two booster coils may be switched into the ignition circuits to provide a good spark at very low RPM. They are controlled by two master switches on the starboard cockpit shelf and two ganged spring-loaded switches, labelled BOOST STARTERS - CALL CLEAR PROP ARC, adjacent to the starter ring-pull. Two warning lights are lit when the master switches are on. When the ganged operating switches are selected down the units can be heard operating (when the engine is not running).

Oil System

15. *Oil Tank.* A single oil tank is between the fireproof bulkhead and the main fuel tank; capacity is 11·75 gallons with 1 gallon air space. A finned oil cooler is in the air flow on the starboard side immediately behind the engine.

16. *Oil Cooler Bypass*. A plunger type oil cooler bypass control, labelled OIL BYPASS VALVE - TO OPEN PULL AND TURN, is below the instrument panel on the port side. When selected to the out position the cooler is bypassed and a quicker warm up achieved. The control should only be used on the ground.

Electrical System

17. An engine-driven generator charges a 24-volt battery to supply the following services: lighting for both cockpits, signalling, fuel content light, booster coils, radios, turn and slip, instruments, landing lamp and pitot heater.

18. A generator charging test socket, voltmeter and ammeter are in the observer's cockpit. A red generator warning light on the left side of the instrument panel comes on when the battery master, labelled BATTERY - ON, is switched ON and the generator is not charging.

Fire Detection

19. A fire detection system switches on a warning light on the top right of the instrument panel if an overheat situation occurs in front of the cylinders.

Fire Extinguishing System

20. A methyl-bromide extinguisher, under the gravity fuel tank, is operated either by an inertia crash switch or by a cockpit switch. The cockpit switch is guarded, painted with black/yellow stripes and is labelled FIRE EXTINGUISHER SYSTEM - SWITCH TO ON WHEN WARNING LIGHT APPEARS. The extinguisher sprays extinguishant in the area at the rear of the engine and, via a spray bar, over the front of the cylinders.

21. A hand-held extinguisher is carried in a rack in one of the rear cockpits.

Aircraft Controls

22. *Rudder Pedals*. The rudder pedals are adjustable only on the ground, access being obtained by removing the fuselage side panels.

23. *Trims*

a. *Rudder.* A rudder bias control is fitted on the pilot's starboard decking. Clockwise operation of the knob trims the aircraft to port.

b. *Elevator.* The aircraft is trimmed in pitch by adjusting the angle of incidence of the tailplane by a large handwheel on the left of the pilot. The indicator is integral with the control.

24. *Ailerons.* The ailerons are conventional. Trim may be altered on the ground by bending a fixed trim tab. In addition to their normal function the ailerons are designed to act as flaps through a separate handwheel at the trailing edge of the upper main plane above the pilot's cockpit. The handwheel is turned clockwise to droop the ailerons up to 8°; the setting is indicated by red painted calibration lines on the inner end of the starboard push-pull tube.

25. *Slats.* Automatic slats are fitted to the outboard upper mainplanes, operating at about 60 knots, to reduce the stalling speed. On the ground in adverse winds one slat may be out and one in; this is normal.

26. *Deck Hook.* The deck hook, its control handle and warning lights are fitted but are inoperable.

Wheelbrakes

27. The main wheels are fitted with differential pneumatic brakes. A brake lever is on the control column. When the lever is operated, air from an accumulator fills annular rubber bladders causing four brake shoes to come into contact with their drum. If the rudders are central, both wheelbrakes operate the same amount. If one pedal is fully forward, that wheelbrake operates, the other does not. The action is progressive dependent on the amount of rudder applied.

28. Air from an engine-driven compressor fills an accumulator to a pressure of 200 ±20 PSI. It is possible to apply up to 80 PSI to the wheel units. The accumulator charges very slowly from the engine driven compressor when on the ground.

29. A geometric lock may be placed over the brake lever to provide a parking facility; however, this does cause a slight continuous leak and should not be relied upon when the engine is not running, nor left on for any time.

30. The accumulator should be recharged by a ground rig if pressure is below 100 PSI on manning the aircraft.

31. After landing, chock the wheels and release the brakes as soon as possible to reduce heat transfer directly through the brake bags.

Tailwheel

32. The tailwheel is fully castoring but biased toward the fore/aft position by a spring-loaded cam arrangement. This requires a slight break-out force when taxying. Additionally, friction tyre damper pads are employed to avoid tailwheel shimmy on landing.

Safety Equipment

33. The pilot is restrained by a normal Z-type 4-point harness and wears a seat type parachute. The pilot's seat may be raised and lowered by means of a seat adjustment lever on the right side. The shoulder harness has a locking lever which should be in the locked position for take-off, landing and display.

34. The rear seat crew are restrained by means of helicopter type despatcher harnesses which should be worn at all times in the air. Chest type clip-on parachutes are provided in each cockpit and a steel stowable back rest is in the gunner's cockpit. During a forced landing the gunner should occupy his seat with the seat back raised.

35. For all over-sea flights of whatever duration, life preservers must be worn; they should be carried in the aircraft at all times. Consider carrying a liferaft for long overwater transits.

36. A first aid outfit is carried in a box which forms the gunner's cockpit footrest.

Radio Installation

37. *General.* The radio installation consists of a PTR1751 UHF and an AD120 VHF. There is a VHF/UHF selector switch on the port side in the front cockpit.

38. *Transmit Switches.* In the front cockpit a transmit switch is on the throttle and there is a standby facility, labelled STBY PTT, adjacent to the UHF control unit

on the port shelf in the front cockpit. In the rear cockpit a switch is on the starboard wall.

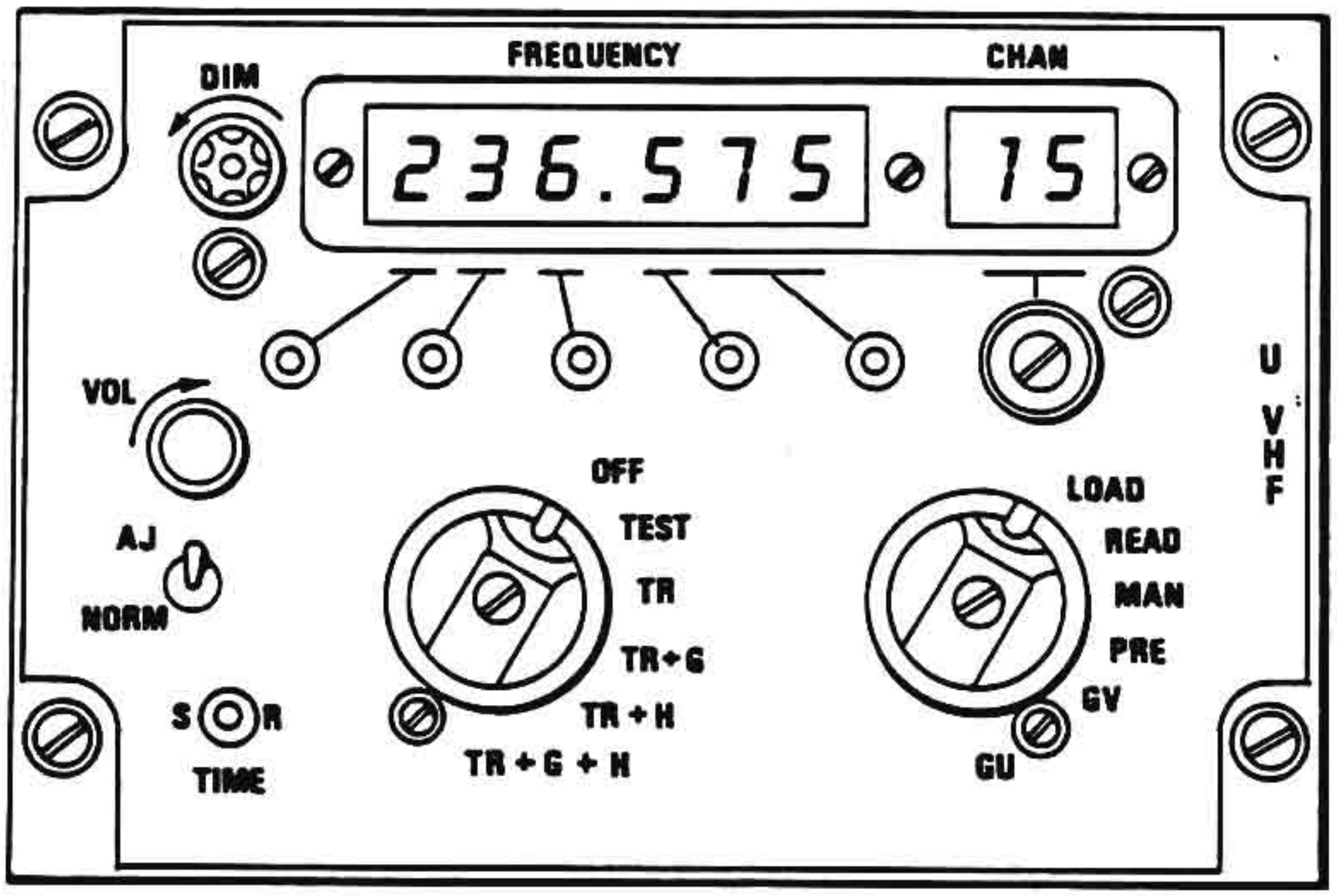
39. *Aerials.* A blade type UHF aerial is inside the rear fuselage. A dipole VHF aerial is on the rear spine.

40. *PTR 1751 UHF.* The UHF equipment consists of two units, the transceiver in the main fuselage and the control unit (Fig 1) on the port shelf in the front cockpit. The transceiver provides voice communication on 7000 channels from 225 to 399·975 MHz at 0·025 MHz spacing. Up to 30 channels can be preset and stored in the non-volatile memory. Access to preset channels is by means of a single rotary switch. Additionally, the UHF guard channel can be selected by either setting the mode switch to GU, for transmit and receive purposes, or by selecting the function switch to TR+G to monitor 243 MHz in addition to the manually selected frequency.

41. *UHF Control Unit.* The PV1754AA control unit incorporates the controls and facilities listed in Table 1. The control unit is integrally lit.

42. *UHF Frequency Loading Procedure*

a. Set function switch to TR.



Part 1 Fig 1 UHF Control Unit

Table 1 - UHF Control

Control/Facility	*Effect/Function*
Function Switch:	
OFF	Power off
TEST	When mode switch is set to MAN the channel FREQUENCY display indicates 888.888 and the CHANnel number indicates 88
TR	Transceiver operates on selected frequency only
TR+G	Normal transceiver operates together with guard receiver on 243 MHz
TR+H	Not used
TR+G+H	Not used
Mode Switch:	
LOAD	Selected preset frequency entered into memory store of channel selected. Blank momentarily then loaded FREQUENCY displayed
READ	Preset channel frequency selected by frequency selection switches ready for loading into selected CHANnel. Preset FREQUENCY displayed
MAN	Manual frequency operation. Frequency changed by frequency selector switches. Manual FREQUENCY displayed
PRE	Pre-selected channel operation. CHANnel selected displayed but FREQUENCY displayed is last selected manual frequency
GV	Inoperative
GU	Operates on 243·000 MHz. FREQUENCY and CHANnel displayed are those last used on MANual
TIME - S/R Switch	Not used
AJ/NORM Switch	Not used. Ensure selected to NORM
VOLume Control	Controls audio output

(continued)

Table 1 - *continued*

Control/Facility	*Effect/Function*
DIM Control	Varies brightness of FREQUENCY and CHANnel displays
Frequency	Frequencies are selected by five 3-position switches, centre-biased to off, they select 100, 10, 1, 0·1 and 0·025 MHz respectively. Digits increase with switch depressed, and decrease with switch raised, at two digits per second

FREQUENCY Display:

Function Switch	*Mode Switch*	*Frequency Display*
TR,TR+G	GU, PRE or MAN	Manual frequency
TR,TR+G	READ	Preset frequency
TR,TR+G	LOAD	Blank momentarily then loaded frequency
TEST	GU	243.000
TEST	MAN	888.888
TEST	PRE or READ	Preset frequency
TEST	LOAD	Blank

Channel Switch	Rotary switch to select one of 30 preset channels. It has an electronic end stop but no mechanical stop. Counterclockwise rotation decreases the channel number to a minimum of 01 and clockwise rotation increases it to a maximum of 30
CHANnel Display	Indicates number of preset channel selected. Indicates 88 with mode switch to MAN and function switch to TEST

b. Set mode switch to READ.

c. Operate channel switch to desired CHANnel.

d. Operate toggle switches to display the desired FREQUENCY.

e. Move the mode switch to LOAD; wait for FREQUENCY to reappear in the display.

f. Repeat items a to e above selecting channels and frequencies as required.

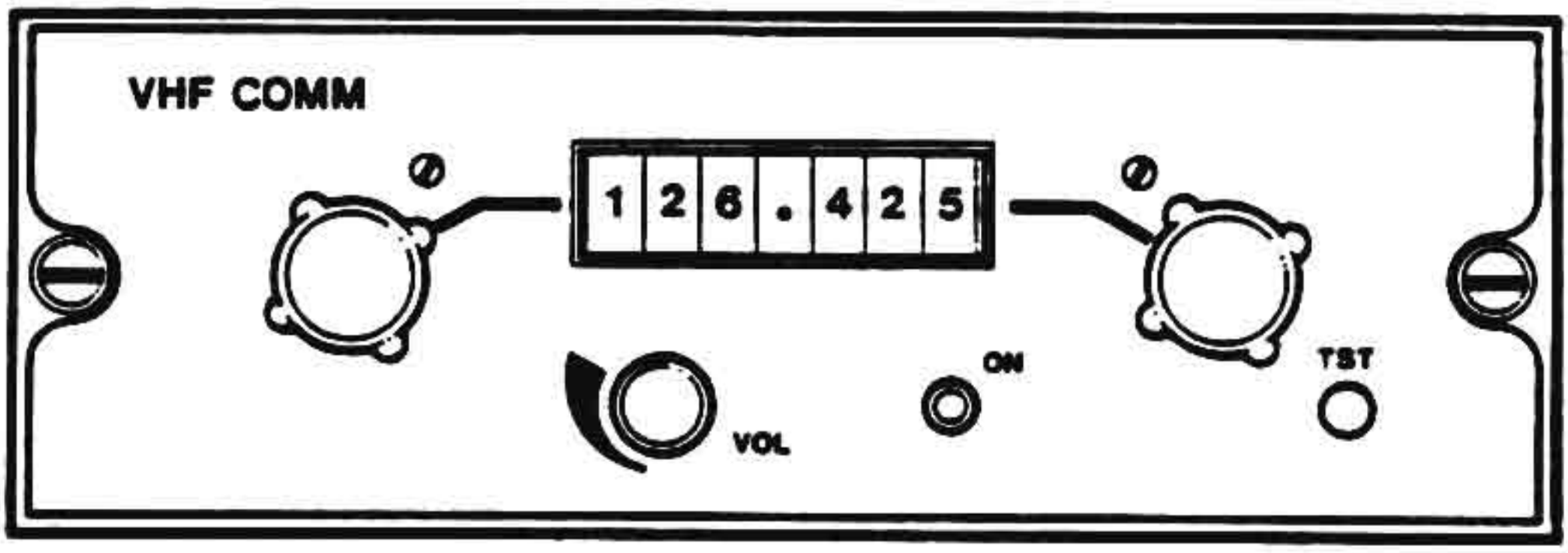
g. Set function switch to TEST and mode switch to PRE. Using the CHANnel selection switch, select each channel in turn and verify the correct programming of the memory.

43. *AD120 VHF.* AD 120 VHF is fitted in addition to the UHF. The equipment provides voice communications on 720 channels in the frequency range 118 to 135·975 MHz at 0·025 MHz spacing. The VHF radio may be operated by selecting the VHF/UHF selector switch, on the port side in the front cockpit, to the VHF position.

44. *VHF Control Unit.* The control unit (Fig 2), marked VHF COMM, is on the starboard side in the front cockpit. It incorporates two rotary frequency selector knobs with an associated digital frequency read-out drum behind a window, a rotary VOLume control knob, an ON/off toggle switch and a TST (test) button. The left frequency knob selects 1 MHz steps and the right knob selects 0·025 MHz steps. The ON/off switch controls the 28-volt DC power supply to the system. The TST button is used to disable the squelch circuit; when pressed, increased noise should be heard in the telephones in the absence of a speech signal, thus providing a confidence check on receiver operation. The ON/off switch must be at ON before the frequency display window is illuminated. The control unit is integrally lit.

Instruments

45. *Compass.* A P11 compass is in the front cockpit; its readings may be observed through a mirror. It is subject to turning and acceleration errors and, therefore, should only be relied upon in straight and level flight at a stable speed.



Part 1 Fig 2 VHF Control Unit

46. *Directional Gyro.* A Mk 1A directional gyro is under the main compass. It should be synchronized with the P11 compass before flight and about every ten minutes during flight. It suffers from pronounced wander and may topple during manoeuvre.

47. *Turn-and-Slip.* An electrical turn-and-slip indicator is controlled by an adjacent circuit breaker. The instrument is both accurate and stable.

48. *Artificial Horizon.* A suction-driven artificial horizon is fitted. It is not a reliable instrument as it tends to wander under normal conditions or topple in manoeuvre.

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PART 2

LIMITATIONS

PART 2

LIMITATIONS

Contents

Engine

1. The Pegasus 30 engine uses:

   a. Fuel: Avgas 100LL, grade 100/130, Nato Code F-18.

   b. Oil: OMD-370, Nato Code O-128 (alternative OMD-250, Nato Code O-125).

2. *Engine Limitations.* The principal engine limitations are given in Table 1.

3. *Oil Limitations*

   a. Normal oil pressure ... ... 60 PSI

   b. Emergency minimum oil pressure (max 15 minutes) 50 PSI

   c. Minimum oil temperature for take-off ... ... 15°C

   d. Minimum oil tank contents ... ... 9 gallons (11·75 normal)

Table 1 - Engine Limitations

	RPM	Boost PSI	Temperature °C Cyl Head	Oil
Take-Off to 1000 feet	2200	+ 0·5	-	-
Climbing (maximum 30 minutes)	2200	Static	210	90
Continuous altitude	2100	minus 0·5	190	80
Normal cruise	1900	approx minus 4		
Diving	2350	+ 0·5		
Emergency	2525	+2	235	100

Note: Any use of the engine above + 0·5 PSI Boost/2200 RPM is to be reported.

Airframe

4. *Position Error Correction.* The pressure errror correction is minus 2 knots at all speeds.

5. *Flying Limitations*

a. The aircraft is limited to low g manoeuvres including wing-overs and steep turns. 60° bank should not be exceeded. Spinning and aerobatics are not permitted.

b. *Speeds*

Maximum ... ... 130 knots

Range ... ... 90 knots

Normal cruise ... ... 90 knots

c. *Maximum Weights*

Take-off and straight flying	...	...	...	9250 lb
All other forms of flying and landing	...	...	...	8750 lb

Note: With full tank, 3 crew, bags, tools and detachment gear, the aircraft weighs under 7600 lb.

5. Wind Limits

a. The normal wind limit is 25 ±5 knots. Crosswind should not exceed 15 knots (10 knots until experienced).

b. The aircraft is susceptible to wake turbulence and slipstream. When conducting a stream take-off it is to occupy the upwind side of the runway.

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PART 3

HANDLING

PART 3

HANDLING

Contents

Management of Fuel System

1. Start and warm up on MAIN ONLY, selecting GRAVITY once running smoothly. Change to NORMAL BOTH before take-off. This acts as a check on the engine driven fuel pump. The level in the gravity tank drops slightly but recovers to full when changed to NORMAL BOTH if the pump is working.

2. When flying on NORMAL BOTH the engine pump maintains the gravity tank full. Keep a regular check on the level of fuel in the gravity tank. A fall in level indicates either:

   a. Main tank is empty. This can be verified from the main tank contents gauge and by the approximate amount of fuel used.

   b. Fuel pump failure.

3. If the engine-driven pump fails, turn on GRAVITY ONLY. Keep the gravity tank full by pumping fuel from the main tank by use of the hand pump on the right of the pilot's seat, or from the observer's cockpit.

4. Fuel usage in ALTITUDE mixture at 90 knots is about 30 gallons per hour. However, for planning purposes, use a figure of 40 gallons per hour.

Starting Engine and Warming Up

5. To start the engine set the controls as follows:

Throttle	0·5 inch OPEN
Mixture control	ALTITUDE
Fuel	MAIN ONLY
Carburettor air intake control	Cold
Oil cooler bypass valve control	In
Ignition switches	OFF
Note static boost pressure	

6. Have the engine turned over nine blades by hand, pumping one stroke of the Ki-gas priming pump as each blade passes the 12 o'clock position. When the engine is warm, priming should not be necessary.

WARNING: If the engine is hot it is dangerous to attempt to hand turn the engine.

7. The starting crew energizes the inertia starter with the starting handle until the starter reaches its peak RPM. Then the pilot switches on the ignition and engages the starter ring and booster coil switches. As the engine turns, operate the Ki-gas pump rapidly until the engine runs smoothly. Screw in Ki-gas pump. Release booster coil ganged switch and select master switches off.

8. If the engine fails to start and over-priming is suspected, ensure the fuel cock is OFF, ignition and booster coil switches are off, open the throttle fully and back turn the engine at least six blades. On the next start attempt do not pre-prime cylinders, but do pump rapidly once the engine is turning. Mis-starting may be due to inadequate starter speed, particularly if the same crew have had to "wind" for two or more starts. A change of crew or a ten minute break may rectify the situation.

Testing the Enqine

9. Warm up at 1100 RPM with the oil cooler bypassed if necessary (knob pulled out). Check the engine temperatures and pressures. Check the brake pressure.

10. *After Warminq Up.* When the oil temperature has reached15°C minimum and the cylinder head temperature 100°C minimum, have two men hold down the tail and open up to 1800 RPM (with the mixture control at ALTITUDE). Check the oil pressure. Switch off each magneto in turn; the decrease in RPM should not exceed 100. If the decrease is excessive and/or the engine runs roughly, throttle back before switching the magneto back on. An excessive decrease can sometimes be cleared by running at 1800 RPM for some time. If men are not available to hold down the tail, carry out the magneto check at 1600 RPM.

Taxying

11. The aircraft is easy to taxy; there are no abnormal characteristics. However, in strong wind conditions it is advisable to have two men on the wing tips to assist and so avoid using all the brake accumulator pressure.

12. If taxying in a confined space, or close to crowds, keep speed very low and have men available to man the wing tips in case of brake failure.

13. If the brakes appear to lose effectiveness in a turn, release the brakes, centralize the pedals, reapply the brakes and if necessary reapply rudder. If brake master pressure falls below 100 PSI, stop the aircraft and set 1600 RPM to recharge the accumulator.

Engine Handling

14. a. Warm up, and cool down, the engine as gradually as possible.

b. Open and close the throttle gradually. This is particularly important when overshooting from an approach or rolling, as rapid opening is likely to cause a rich cut, resulting in the engine failing to produce the requisite power. If encountered, this condition should eventually clear itself.

c. Do not dive the aircraft at high speed with the throttle closed, as this can lead to carburettor icing. Maintain at least one third throttle.

d. Avoid prolonged low speed high power climbs on hot days as this can cause rapid engine overheating.

e. There is only one temperature sensor on the engine, at the rear of No 5 cylinder.

f. To prevent plug oiling select the mixture to ALTITUDE during taxying and always reset 1100 RPM when stationary.

Take-Off

15. Carry out the **Checks Before Take-Off** as in the FRC.

16. Line up on the centre line. Open the throttle slowly to static boost. Any tendency to swing can be easily counteracted by the rudder. Unstick at about 60 knots. Do not attempt to climb until 70 knots has been attained.

17. It is possible to unstick on short grass within 1000 feet using static boost.

18. In the RICH setting it is possible to achieve +2 PSI boost during take-off. Take care to limit boost to a maximum of +0·5 PSI except in emergency.

Climbing

19. Before reducing RPM return the mixture control to ALTITUDE. Climb at 70 knots.

General Flying

20. *Stability*. The aircraft is stable about all axes. The rudder is sensitive at all speeds. The aileron control is slightly heavy but well balanced. Careful use of the rudder is necessary to make correct turns; this is more noticeable in right-hand turns.

21. *Cruise*. The range speed of 90 knots is achieved at approximately 1900 RPM. Cruising speed may be increased to 100 knots with little increase in fuel consumption. Higher cruise speeds increase vibration and slipstream and are damaging to airframe and crew respectively.

22. *Poor Visibility.* For flying in poor visibility reduce boost to maintain height at 80 knots.

23. *Noise.* Noise levels in the cockpit can make radio reception difficult. Throttling back helps. The crew can sometimes hear better when crouching out of the slipstream in the observer's cockpit.

Stalling

24. There is little warning of the stall other than a sink. The stall is extremely gentle and during recovery the aircraft regains flying speed immediately. There is no tendency to spin.

25. *Stalling Speed.* The stalling speed is between 48 to 52 knots wings level with power off.

26. *Flaps.* Aileron droop has little effect on the stalling speed but does have a stiffening effect on the ailerons making the aircraft less easy to fly. For these reasons, aileron droop is rarely used and it is recommended that it is left up.

Spinning

27. Spinning is not permitted, but if a spin inadvertently occurs, apply normal recovery action immediately.

Diving

28. It may be necessary to trim the aircraft slightly into a dive; otherwise, it behaves normally. Recovery should be as gradual as possible; avoid violent use of the elevator.

Display Flying

29. For display flying set the mixture RICH and restrict boost to static.

30. Only gentle manoeuvres such as wingovers are possible; avoid application of g as there is no accelerometer fitted. Do not allow the speed to decrease below 65 knots during wing-overs.

31. The Ensign should be raised at about 65 to 70 knots and, to limit the strain on the fuselage structure, not flown above 80 knots. Fitting and removing the flagpole is difficult and should always be carried out wings level.

Approach and Landing

32. Carry out the **Checks Before Landing** as in the FRC.

33. *Threshold Speeds*. The threshold speeds are:

Engine assisted	...	65 to 70 knots
Glide	...	70 to 75 knots

34. *Landing Distance*. The aircraft can be brought to rest in about 1000 feet. A main wheel landing is preferred to preserve tailwheel tyre life.

35. *Mislanding*. In event of a mislanding open the throttle smoothly to take-off boost, trim forward and climb at 70 knots.

Stopping the Engine

36. To stop the engine run at 1100 RPM for one minute, carry out a dead cut check and then pull the slow-running cut-out. Switch off the magnetos. Turn OFF the fuel cock and the battery master switch.

Note: Oil drains and fouls the lower plugs after shutdown. Leave the engine to cool for a minimum of 90 minutes and then remove and clean the lower plugs. If not allowed to cool, the act of plug removal is likely to strip the threads in the alloy cylinder heads. The engine should start and run normally if required inside the 90-minute cooling period.

PART 4

EMERGENCIES

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Contents

Rough Running Engine

1. In the event that the engine runs roughly:

   a. If on the ground, do not attempt to take-off.

   b. Check that both magneto switches are ON.

   c. Check that booster coils are off.

   d. Set the mixture to RICH.

   e. Check the fuel tank contents; change the cock selection.

   f. Check that the priming pump is screwed home.

   g. Select carburettor air hot if in cold or cold if in hot.

   h. Gently move the throttle to find the most 'comfortable' RPM.

i. Avoid closing the throttle unless in a good position for a forced landing.

j. If still rough running, make a "PAN" call.

k. Gain altitude if possible; keep within range of open spaces and divert to the nearest airfield.

l. Inspect the cylinders as far as possible; if one has lifted, a major oil leak is probable. Monitor the oil pressure and temperature carefully.

m. If the engine appears to be in imminent danger of stopping, try pumping the priming pump.

n. If rough running causes insufficient power to maintain altitude, switch OFF each magneto in turn to see if that improves matters. If it does not, leave both magnetos ON.

Engine Failure

2. If the cause of an engine failure is unknown and there are no signs of mechanical failure, run through as many of the following items as time and prudence permit.

a. Check that the ignition switches are ON.

b. Change the fuel cock to an alternate setting.

c. Select the carburettor air control to hot.

d. If necessary, dive the aircraft to keep the propeller turning.

e. Pump the priming pump.

f. Select the booster coils master switch on.

g. Hold the booster coil ganged switch down.

Forced Landing

3. If the engine fails to respond or has stopped:

   a. Warn the crew.

   b. Make a distress call.

   c. Select the ignition switches OFF.

   d. Select the fuel cock OFF.

   e. Check harnesses are locked and tight.

   f. Descend at 80 knots; threshold 70 to 75 knots.

Note 1: Flight should not be continued unnecessarily if the engine has failed but has been restarted - or substantially faltered and then recovered. Height should be maintained as long as possible and a steep forced landing made to the nearest large into wind grass field or airfield, as appropriate and/or convenient.

Note 2: With the propeller stopped a steeper than practised glide angle is required to maintain speed. Aim to be high and use sideslip on finals.

Low Oil Pressure

4. If oil pressure falls to or below 50 PSI:

   a. Check temperature.

   b. Check the cooler bypass is closed.

   c. Divert to the nearest suitable landing area.

   d. If the oil pressure drops to zero the engine is likely to seize and therefore it should be deliberately stopped and the aircraft force landed.

High Oil Temperature

5. If an oil temperature of 90°C or above is observed:

   a. Check the oil pressure.

   b. Check that the cooler bypass is closed.

   c. Reduce power and increase airspeed if possible.

Generator Warning

6. If the generator warning light comes on, reduce electrical load:

   a. Lights off.

   b. Use VHF radio sparingly.

   c. Turn UHF radio off if possible.

   d. Turn pitot heater off if conditions allow.

Fire in the Air

7. In the event of fire in the air carry out these actions:

   a. Warn the crew.

   b. Throttle to idle if practicable.

   c. Reduce airspeed to minimum practicable.

   d. Operate the fire extinguisher.

8. If the fire goes out:

   a. Use minimum power.

   b. Land as soon as possible.

9. If the fire continues:

   a. Select the fuel OFF.

   b. Switch the ignition OFF.

   c. Carry out a forced landing or abandon the aircraft (minimum 1500 feet AGL).

Cockpit Fire

10. In the event of a cockpit fire:

   a. Select the battery master off.

   b. Use the hand held extinguisher.

   c. Land as soon as possible or abandon.

Note 1: If time permits, make a distress call before switching the battery off.

Note 2: It is possible to disconnect the battery while in the air by the rear crew crawling under the pilot's seat.

Fire on the Ground

11. On the ground immediately a fire is suspected, or indicated, the engine must be shut down and the aircraft vacated. Do as much of the following as time and situation permit:

   a. Switch the magnetos OFF.

   b. Select the fuel OFF.

   c. Operate the engine fire extinguisher.

   d. Make a distress call on the in-use frequency.

   e. Switch the electrics off.

f. Release the brakes if the situation permits.

g. Vacate the aircraft carrying the hand held extinguisher.

Brake Failure

12. If, in the air, the brake master pressure is noted to be zero or low, or wheel pressures dissipate when the brakes are selected on, divert to an airfield with an into-wind runway at least 3000 feet long. Do *not* land at the display site. The aircraft may be landed normally and the engine switched off once on the ground. The aircraft stops within 3000 feet without brakes and directional control should be maintained easily. Increasing crosswind makes directional control more difficult. As speed washes off, the aircraft tends to turn into wind. Directional control and retardation characteristics are better on grass than on concrete.