CHECK LISTS

CHECKS BEFORE TAKE OFF

(a) AIRFIELD

Throttle	Adjust friction.
Trimmers	All neutral
Aileron gear setting	POWER. Peg at bottom of quadrant
Airbrakes	IN
Wings	Spread and locked. Indicators black. External indicators flush with wing surface. Both levers in gates in fully aft position. Wing fold doors closed.
Fuel	H.P. and L.P. cocks fully on. Contents. Booster-pump ON. Fuel pressure indicator black. Tip tank fuel jettison switch CLOSED. (JETTISON if tip tanks empty.)
Flaps	30° down.
Instruments	FLT INST switch on. Artificial horizon erect. Turn and slip functioning. Main inverter indicator black. Pressure head heater on. Check Mk. 4F compass with E2.
Oxygen	ON. Blinkers and indicator annunciating.
Hood	Shut and locked. Seal inflated. Direct vision panel closed. Cockpit pressure control OFF, HOT, or REDUCE.
Harness	Tight and locked.
Flying controls	Ailerons in POWER warning indicator black.

(b) CATAPULT

The following alterations and additions should be made to check list (a):—

Trimmers	Elevator Neutral
Flaps	45°
Wheel brakes	Off

CHECKS BEFORE LANDING

AIRBRAKES	IN
ARRESTER HOOK	AS REQUIRED (Check hook light. Comes on, if hook has been selected down)
BRAKES	Check Pressures. Off.
Undercarriage	Locked down. Selector lever in slot. Three green lights.
Fuel	Contents.
Flaps	Fully down on final approach.
Harness	Tight and locked.

THRESHOLD SPEEDS

Max. weight	120 knots.
Normal weight	110 knots
Carrier	110–114 knots.

INSTRUMENT APPROACH

DOWNWIND		
8,000 r.p.m.	0 Flap	140 kn.
BASE LEG		
8,000 r.p.m.	¼ Flap	135 kno.
GLIDE PATH		
8,000 r.p.m.	¼ Flap*	130 kn.

* Flaps may be lowered fully when runway comes into view.

ENGINE LIMITATIONS

Take-off and operational necessity (3½ mins.)	10,250 r.p.m.*	760° C
Max. continuous	9,750 r.p.m.	660° C
Approach (minimum)	5,000 r.p.m.	—
Ground idling	3,000 ± 200	450° C

* Reduce to 10,000 above 25,000 ft. in climb or 35,000 ft. in level flight.

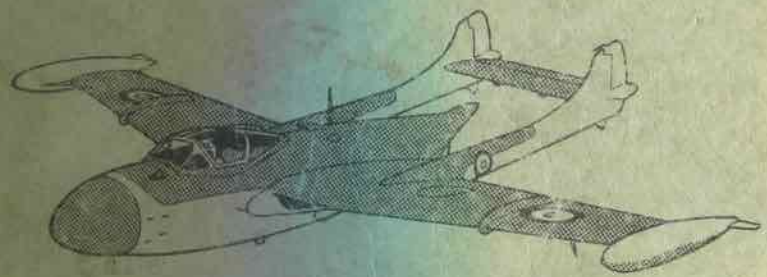
2nd Edition
Aug. 1960.

PILOT'S NOTES

SEA VENOM

F.A.W.53

(with ejection seats)



Navy Office,
Canberra, A.C.T.,
August, 1960.

A.P. 4360C-P.N. (2nd Edition) — Pilot's Notes, Sea Venom, F.A.W. 53 (with ejection seats) — having been approved is hereby promulgated.

By direction of the Naval Board.

Thos. J. Hawkins

RESTRICTED

NOTES TO USERS

Notes are complementary to A.P.129 (6th Edition), and assume a thorough knowledge of the chapters are relevant to the operation of this type of aircraft.

nal copies may be obtained from Naval Store Officer undock Street, Randwick, Sydney New South Wales, lication on Form A.S.134d. The number of the tion must be quoted in full—A.P.4360C—P.N.(2nd Edition)

nts and suggestions should be forwarded through the hannels to the Naval Board.

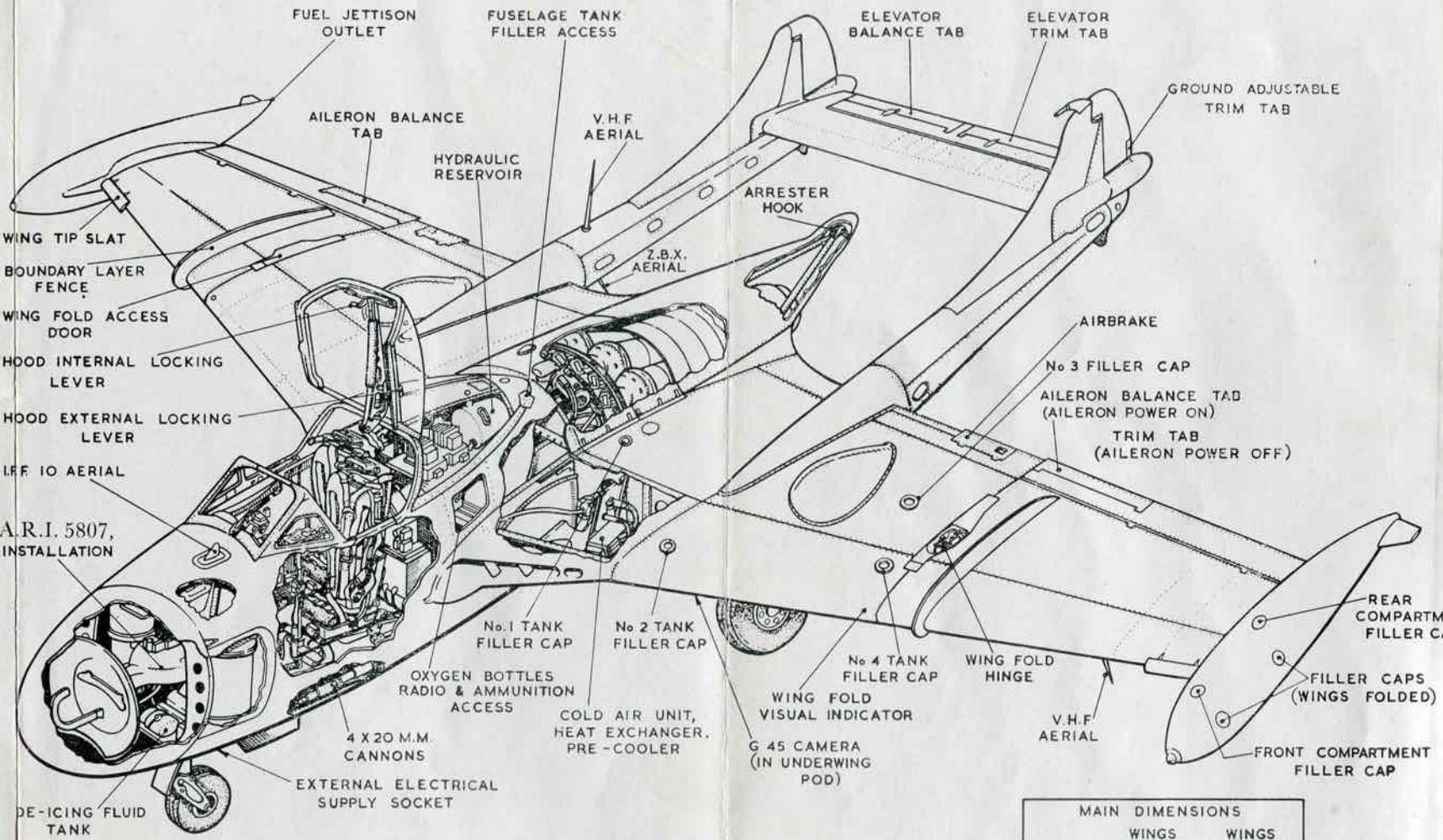
AMENDMENTS

ment lists will be issued as necessary and will be d for affixing to the inside front cover of these notes.

mendment list will, where applicable, be accompanied nmed slips for sticking in the appropriate places in the

oration of an amendment list must be certified by ng date of incorporation and initials below.

INITIALS	DATE	A.L. NO.	INITIALS	DATE
		4		
		5		
		6		



MAIN DIMENSIONS	WINGS FOLDED	WINGS SPREAD
SPAN	23' 0"	42' 10"
HEIGHT	9' 7"	8' 6" (13' 11" DURING SPREADING)
LENGTH	36'-8"	

SEA VENOM F.A.W. 53
(WITH EJECTION SEATS)

SEA VENOM F.A.W.53

LIST OF ASSOCIATED PUBLICATIONS

Title	A.P. No.
Sea Venom F.A.W.53 descriptive handbook	4360C Vol. I
Ghost Mk. 10400 series E.C.U.	4320B
Fuel system components for gas turbine aero engines	4282 series
Electrical equipment manual	1095 series 4343 series
Starting systems for aero engines	1181 series
Lockheed aircraft hydraulic equipment ...	1803B
Lockheed aircraft undercarriage equipment	1803C
Lockheed powered flying control units ...	4602A
Pneumatic equipment, aircraft, Hymatic ...	4303C
Pressurizing and air-conditioning equipment aircraft	4340
Wheels, tyres, and brake systems	2337
Signal manual	1186 series
Instrument manual—general instruments ...	1275A
Instrument manual—navigation instruments	1275B
Safety equipment manual	1182 series
Gyro gunsight	1275E
Cine-cameras and accessories	1355D
Guns, Hispano 20 mm.	1641F
Air pump units	1519
Aircraft operating and servicing under low temperature conditions	1441A
Ejection Seats — R.N. aircraft	4288N
Aircraft rocket installations, ammunition and R.A.T.O. (Royal Navy)	2802B
Radar Type A.I. Mk. 17	2892F

NAVY OFFICE
August, 1960

A.P. 4306C-P.N.
Pilot's Notes
2nd Edition

SEA VENOM F.A.W. 53
with ejection seats

LIST OF CONTENTS

PART I—DESCRIPTIVE

ARMAMENT EQUIPMENT

PART II—LIMITATIONS

PART III—HANDLING

MANAGEMENT OF SYSTEMS

STARTING, TAXYING AND TAKE-OFF

HANDLING IN FLIGHT

SEA VENOM F.A.W. 53
With Ejection Seats
(See NOTES TO USERS)

PART I
DESCRIPTIVE

NOTE.—Throughout this publication the following conventions apply:—

(a) Words in capital letters indicate the actual markings on the controls concerned.

(b) The numbers quoted in brackets after items in the text refer to the illustrations in Part VI.

(c) Unless otherwise stated, all airspeeds and mach numbers quoted are "Indicated."

1. Introduction

(a) The Sea Venom F.A.W 53 is a naval, carrier-borne, all-weather fighter accommodating a crew of two and A.I. radar equipment. It is powered by a Ghost Mk.104 engine (4,950 lb. sea level static thrust) and is equipped with powered ailerons and a pressurised cockpit.

(b) The armament consists of four 20 mm. Hispano guns, and provision is made for the installation of R.P.

(c) Mod. 759 introduced Mk. 4A lightweight ejection seats. Associated modifications introduce a trans-illuminated instrument panel and a Mk. 4F gyro compass instead of a Mk. 4B.

MAIN SERVICES

2. Hydraulic system

(a) Two engine-driven hydraulic pumps on separate shafts provide pressure at 2,500 lb./sq. in. for the operation of the:—

Undercarriage

Flaps

Airbrakes

Wing folding

Arrester hook

Aileron power units

Wheel brakes

Windscreen wiper

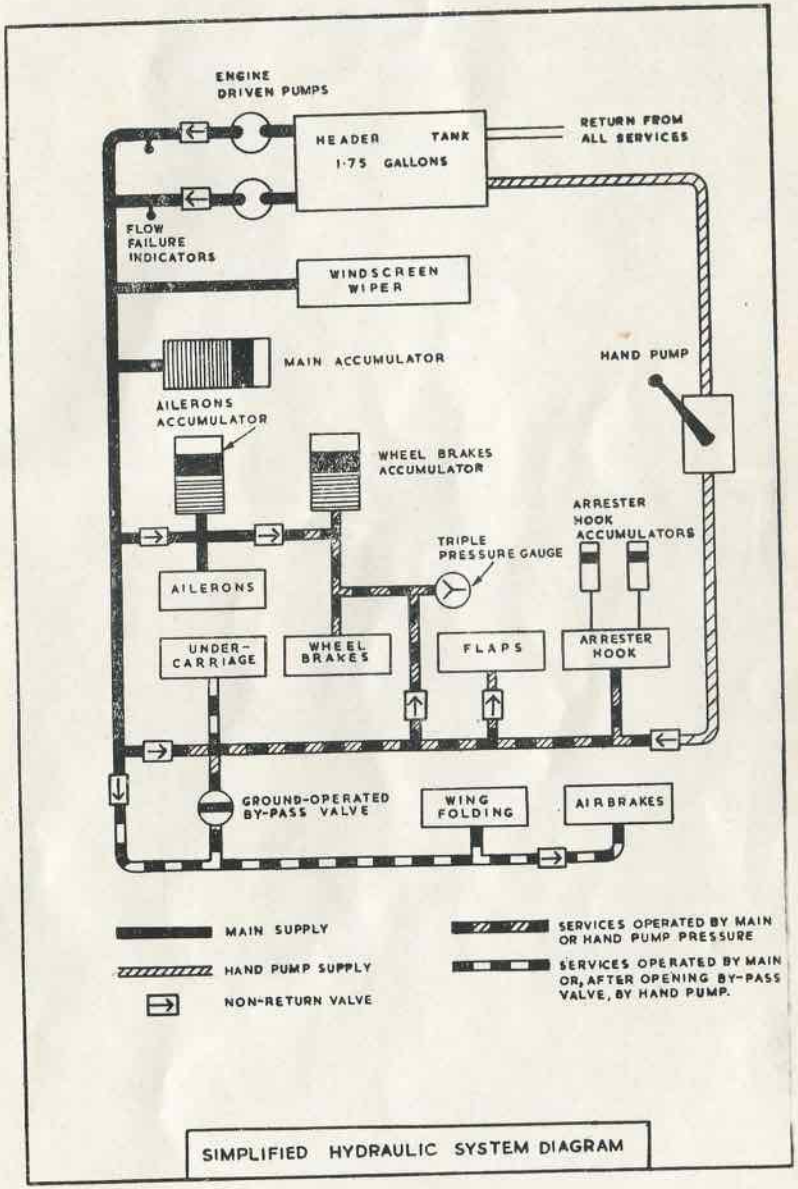
(b) Three accumulators store hydraulic fluid at the operating pressure of the system and ensure rapid normal operation of the services which they supply; in addition they provide a reserve of pressure in an emergency. The services they supply are:—

(i) *Main accumulator* (1,250 *lb./sq. in.*). All services but the capacity is such as to provide in emergency only one one-way operation of the undercarriage and flaps and for restricted use of the brakes on the landing run.

(ii) *Ailerons accumulator* (1,250 *lb./sq. in.*). Aileron power units in flight and also, in certain circumstances, the wheel brakes after landing.

(iii) *Wheel brakes accumulator* (1,800 *lb./sq. in.*). Wheel brakes only. This accumulator only may be charged by the handpump.

(c) Two subsidiary damper accumulators (1,700 lb./sq. in.) are connected to the arrester hook circuit. These absorb the fluid displaced by the partial retraction of the hook during deck landing



SIMPLIFIED HYDRAULIC SYSTEM DIAGRAM

(d) Warning that either pump has failed is given by two warning lights in the cockpit, situated one on the left of the G.G.S. and the other (47) at the top of the starboard direct-vision panel. They provide an indication of lack of flow rather than lack of pressure.

(e) If complete hydraulic failure occurs, the handpump (66) between the seats can be used to provide pressure for the operation of the undercarriage, flaps, arrester hook and wheelbrakes. On the ground only it may also be used to operate the airbrakes and wing-fold circuits after opening a valve at the aft end of the gun bay. The handpump will not operate the aileron and windscreen wiper circuits.

3. **Pneumatic system**

(a) The pneumatic system is used to provide air pressure for inflating the hood seal and for pressurising the radar scanner and waveguide.

(b) A single, engine-driven compressor charges two interconnected air bottles contained in the nose of the aircraft. A ground charging connection is on the starboard side of the fuselage, forward of the cockpit.

(c) The main air bottle pressure is 450 lb./sq. in. and reducing valves give pressures of 10 lb./sq. in. for the hood seal and the radar scanner and waveguide.

4. **Electrical system**

(a) *Battery supply*

A battery master switch (77), when set to ISOLATED, disconnects the single 24-volt battery from all services except the engine fire extinguishers. The switch should normally be ON before starting and at all times when the engine is running.

(b) *D.C. generators*

(i) Two engine-driven generators, each having an output of 200 amps at 27.5 volts, maintain a constant voltage supply.

(ii) There are two sets of generator failure warning lights, one set (37) on the pilot's instrument panel and the other set (73) on the starboard shelf. Both sets operate in parallel so that, whenever a generator is not supplying power, the appropriate warning light in each set comes on. The lights should go out after starting at approximately 3,500 r.p.m.

(c) *External D.C. supply*

Ground testing of the electrical services may be carried out with an external battery plugged into the socket under the fuselage nose on the port side. The battery master switch must be ON if an external source is connected during starting, to prevent relay chatter.

(d) *Flight instruments A.C. supply*

(i) A.C. for the flight instruments is provided by one of two inverters run off the D.C. supply. The circuit breakers (at 72) for the inverters are on the starboard shelf and are labelled INSTRUMENT INVERTERS, MAIN and STANDBY. When they are in and the FLIGHT INSTRUMENTS master switch (52) is on, the standby inverter is started. After starting the engine, the main inverter is brought into operation when the engine r.p.m. reach generator cut-in speed (3,000-4,000 r.p.m.); this inverter then takes over from the standby.

(ii) With the undercarriage up, the FLIGHT INSTRUMENTS master switch is by-passed, ensuring that the standby inverter supply will not be cut off, even if the switch is inadvertently moved to off.

(iii) If the main inverter fails, a torque switch operates and automatically connects the standby inverter to the flight instruments. A magnetic indicator (38) marked MAIN INVR FAIL, is at the top of the instrument panel and shows black when the main inverter is in operation and white when the standby inverter is in operation or when electrical supply is not available.

(iv) The inverters may be tested before starting the engine by the use of two switches (98) on the starboard shelf. When the inboard GROUND TEST switch is set on, the main inverter can be heard to operate and the instruments seen to erect. When the switch is set off, the inverter stops operating. When the outboard

spring-loaded switch is held up, with the GROUND TEST switch on, auto changeover occurs and the standby inverter operates; the inverter failure indicator should then show white. After testing, set both switches off.

(e) Radar A.C. supply

A.C. for the A.I. Mk. 17 and the I.F.F. Mk. 10 is supplied by two inverters; a Type 103 in the gun bay and a Type 201 in the nose compartment. These inverters are controlled by switches (75) on the radar control panel, on the starboard side of the cockpit. The inverters impose a large current drain on the aircraft battery and should, therefore, not be running during starting operations.

(f) *Emergency D.C. supply*

In the event of electrical failure, a 24-volt alkaline battery provides power for the two emergency lamps and the turn-and-slip indicator. The endurance of this battery is approximately 45 minutes with both lamps and turn-and-slip in use.

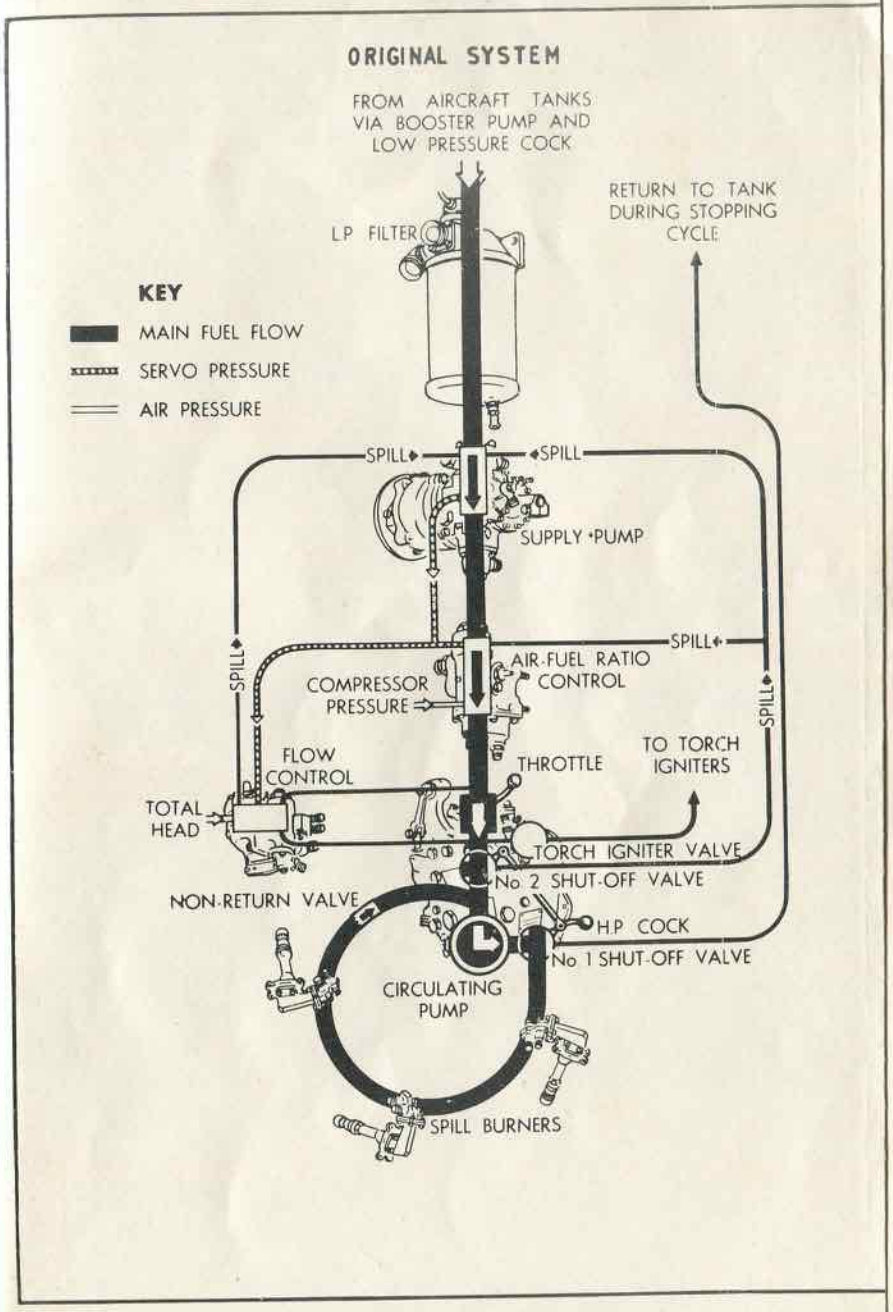
FUEL AND OIL SYSTEMS

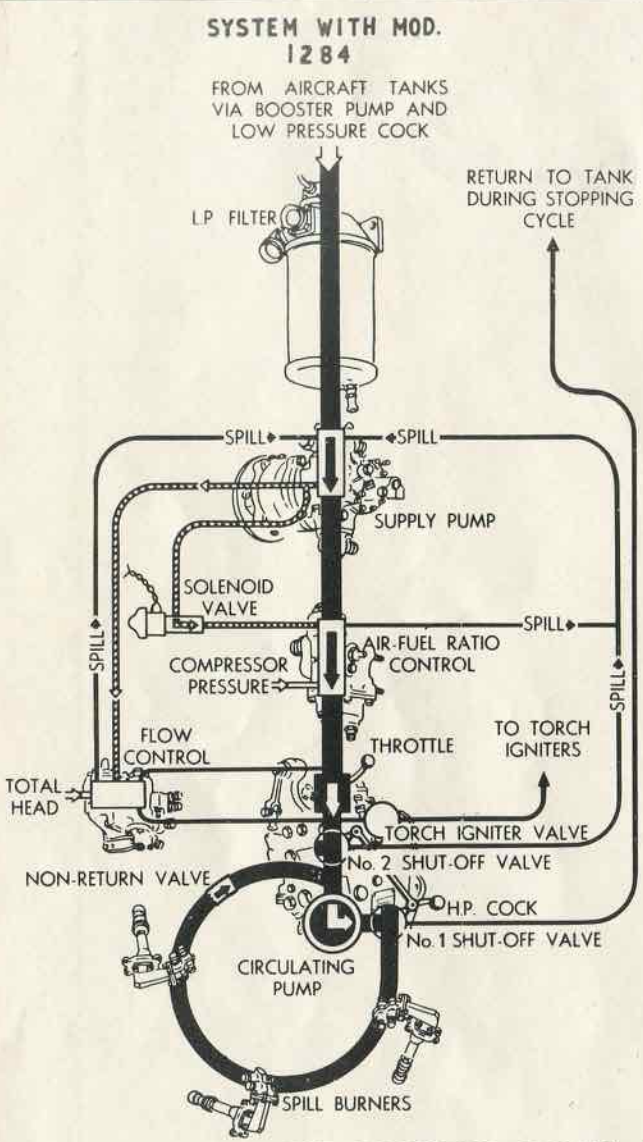
5. Fuel tanks

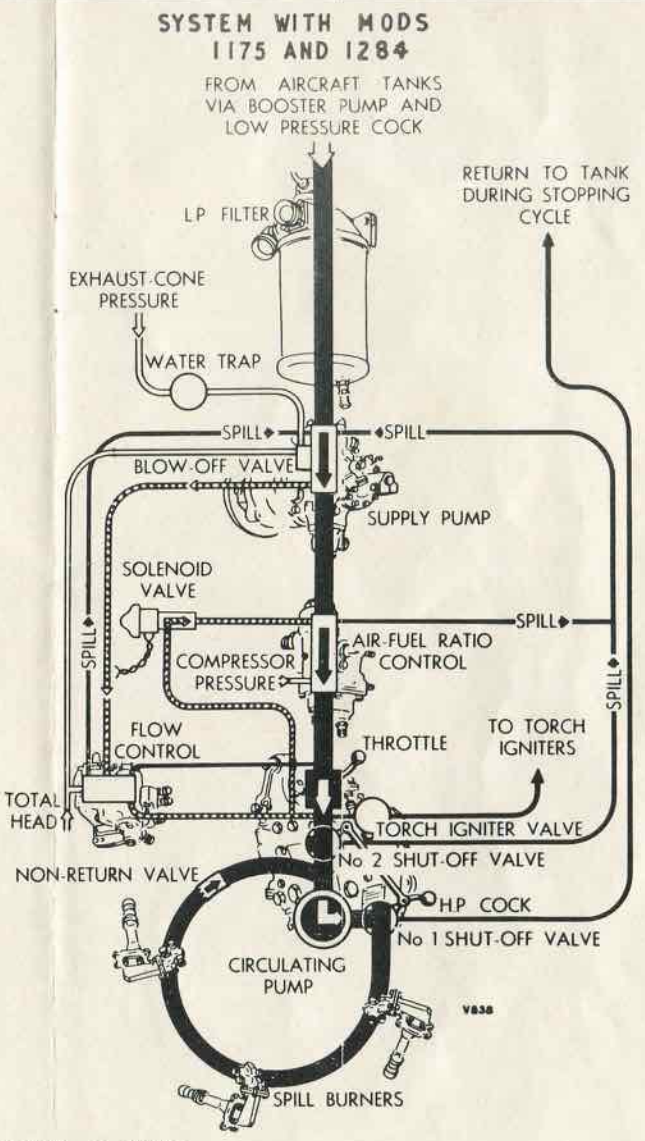
(a) Nine internal tanks are carried, one in the fuselage and four in each wing. Wing-tip tanks are fitted from which the fuel is jettisonable.

(b) The tank capacities are as follows:

	Gallons	lb. AVTUR (8 lb./gall.)
Fuselage tank	90	720
Eight wing tanks		
(pre-Mod. N.833) ..	221	1,768
(post-Mod. N.833) ..	216	1,728
Wing-tip tanks	150	1,200
Total ..	461 (pre-Mod. N.833)	3,688
	456 (post-Mod. N.833)	3,648







THE SOLENOID VALVE AND AIR FUEL RATIO CONTROL UNIT HAVE BEEN RENDERED IN-OPERATIVE ON R.A.N. ENGINES

All internal tanks are pressure-vented to atmosphere. Transfer from the wing-tip tanks is by air pressure, and from the wing tanks, by gravity.

(c) *Collector box*

The collector box in the base of the fuselage tank contains enough fuel to keep the engine running up to the limit of 10 seconds under negative G loading, or when flying in attitudes near the vertical.

(d) *Unusable fuel*

80 lb. of fuel, increasing with tail-down attitude to 175 lb. (10 to 22 gallons) are unusable.

6. **Contents gauge**

(a) A two-scale contents gauge (57), at the right of the instrument panel, shows the total contents, in pounds, of all internal tanks, whenever electrical power is available. When the button to the right of the gauge is pushed, the gauge will indicate the contents of the fuselage tank only. There is no gauge for the tip tanks, but when the tip tanks transfer ceases, the fuselage tank gauge reading will probably drop rapidly to 30-40 gallons. (240-320 lb.)

(b) On pre-Mod. N.209 aircraft, a similar gauge, calibrated in gallons, may be fitted. This type of gauge is less accurate than the gauge calibrated in pounds.

7. **Transfer system**

All fuel is transferred to the fuselage tank, and from there to the engine. The sequence is as follows:—

(a) *Tip tanks*

Transfer commences by air pressure, tapped from the engine diffuser casing, when the level in the fuselage tank has fallen by approximately 120 lb. (15 gallons). When transfer from the tip tanks is taking place, or when no electrical supply is available, the magnetic indicators (40)

at the right of the instrument panel show black. When transfer pressure is insufficient or when transfer is complete, they should show white.

(b) *Internal wing tanks*

When the level in the fuselage tank has fallen sufficiently, 240-320 lb. (30-40 gallons) remaining, transfer starts from the internal wing tanks by gravity only.

8. **Booster-pump**

(a) A booster-pump in the base of the fuselage tank delivers fuel through the L.P. cock to two engine driven H.P. fuel pumps. If the booster-pump fails, fuel by-passes the pump by gravity. A magnetic indicator (41) shows white when either delivery pressure falls to $1\frac{1}{2}$ lb./sq. in. or when the pump is switched off.

(b) The booster-pump is controlled by a switch (53), on the centre switch panel, marked FUEL PUMP. The circuit breaker (at 72) is on the starboard shelf above the test socket and switch (83).

9. **L.P. cock**

The L.P. cock lever (22) is on the underside of the engine control box and is marked OFF-FUEL-ON (OFF down and aft, ON forward and up). The L.P. cock should be closed in the event of an engine fire but must not be used to stop the engine, except in an emergency, as the H.P. pumps will be damaged and the fuel system aerated.

10. **Wing-tip tanks fuel jettison switch**

The guarded jettison switch (9) on the port shelf is marked TIP TANK FUEL—JETTISON/CLOSE. When put to JETTISON, two ports, one at the aft end of each wing-tip tank, are opened and fuel is driven out by air pressure from the engine, through pipes which communicate with *the front compartments* of the tanks only. The ports can

be closed at any time so that partial jettisoning of the fuel load is possible. It takes approximately one minute for the full load to be jettisoned. The jettison switch must always be set to JETTISON whenever transfer from the tip tanks is complete and at any time when the tanks are empty.

11. **Oil system**

Oil is carried in the engine sump only, the capacity of which is 18 pints. A temperature gauge (70) is at the bottom centre of the instrument panel. In addition to the sump capacity, 3 pints of oil are contained in the system. Over-filling of the system may cause high oil temperatures and/or a visible loss of oil in flight.

ENGINE CONTROLS

12. **Ghost Mk. 104 engine**

(a) *General*

The engine is a centrifugal turbo-jet engine, developing 4,950 lb. static thrust at sea level. The main systems include:—

A two-shot cartridge starter system (see para. 13).

A relighting system (see para. 14).

A spill-flow high-pressure fuel system.

A self-contained oil system.

(b) *High-pressure fuel system and H.P. cock*

(i) The high-pressure system is of the "spill-flow" principle. Two pumps are used, one a circulating pump to supply fuel to the burner inlets and to draw fuel from the spill return lines of the burners, and the other a delivery pump to supply metered fuel between the spill line and the circulating pump inlet. A priming valve is incorporated to accelerate the priming of the spill line.

(ii) An acceleration control unit (A.C.U.) is connected downstream of the delivery pump and a flow control unit (F.C.U.) downstream of the throttle. The F.C.U. maintains constant fuel pressure for any given altitude, forward speed and throttle setting and the A.C.U. ensures an acceptable air/fuel ratio during periods of engine acceleration. The A.C.U. and F.C.U. control the output of the delivery pump by a common servo system.

The A.C.U. has been blanked off on R.A.N. engines. Care must be exercised to avoid rapid acceleration to prevent overfuelling and overheating.

(iii) *Negative rate governor*

Ghost Mod. 1175 introduces a negative rate governor. When this modification is incorporated, full throttle engine r.p.m. are automatically and progressively reduced from the maximum (10,250) at 25,000 ft. to 10,050 at 45,000 ft. and above, thus obviating the necessity for throttling back during the climb.

(c) *Throttle control*

The throttle lever (13) is in a quadrant on the port side of the cockpit. The lever incorporates a G.G.S. range control and a V.H.F. press-to-transmit button (14). A damper (21) is inboard of the box and is rotated clockwise to tighten.

13. **Starting system**

(a) The engine is started by a cartridge system. The engine STARTER MASTER switch (51), on the centre switch panel, must be ON to energise the firing circuit. The cartridge is fired by pressing in the STARTER button (48) above the starter master switch; the button is then held in electro-magnetically for 20-30 seconds and during this time the high energy ignition system is in operation. During a normal start, the turbo-starter brings the engine r.p.m. up to approximately 1,500. The r.p.m. will then drop to approximately 1,100-1,200 when light-up should occur. The engine should then accelerate up to the normal idling r.p.m. of 3,000.

(b) The starter system contains two cartridges; the second one is auto-selected as the starter button resets. Four spare cartridges may be stowed in the aircraft, two in each flap compartment.

14. **Relighting control**

An engine relighting pushbutton is incorporated in the end of the H.P. cock lever (10). It should be pressed to energise the igniter plugs when relighting in flight, and may be used as an audible check that the H.E. ignition is functioning, before starting up. The relight system will operate irrespective of the position of the engine starter master switch.

15. **Engine instruments**

The following engine instruments are provided:—

R.P.M. indicator

J.P.T. gauge.

Oil temperature gauge (70).

16. **Engine fire warning light and extinguishers**

(a) *Fire warning*

The combined extinguisher pushbutton and warning light (at 56) is located on the port canopy rail together with a pushbutton (at 56) for testing the light. The flame switches are of the resetting type; if the fire is extinguished the light will go out.

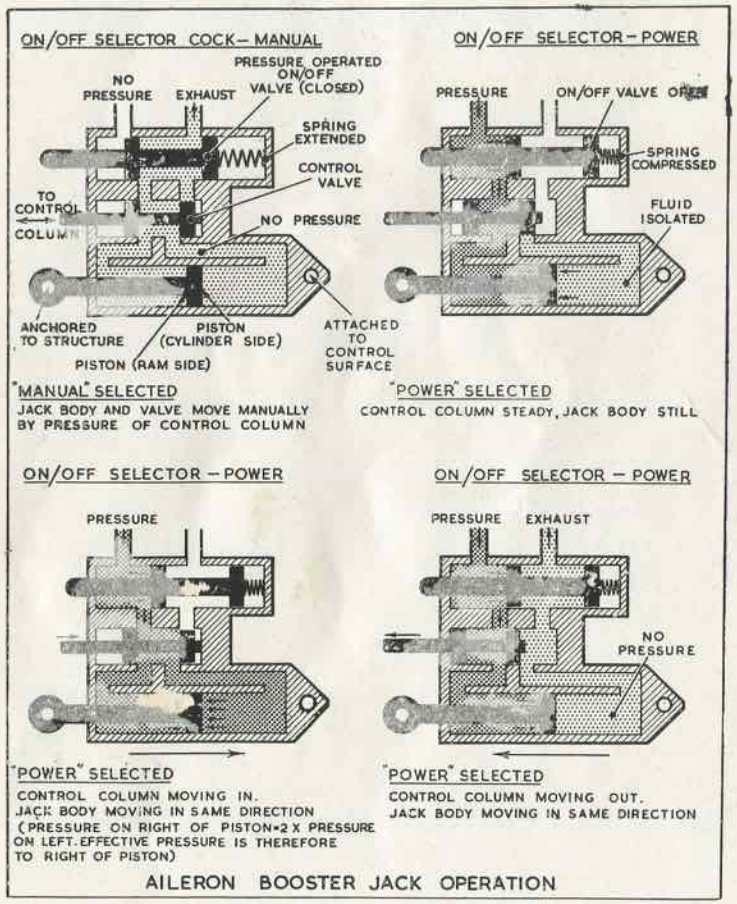
(b) *Fire-extinguishers*

Two fire-extinguisher bottles, stowed one in each flap shroud, are operated by pressing the pushbutton (described in (a) above). The contents of the extinguishers are discharged from spray nozzles on either side of the diffuser casing. The cockpit pressure control must be OFF before the system is operated. The system will operate irrespective of the position of the BATTERY master switch.

POWERED AILERONS AND ASSOCIATED CONTROLS

17. **General**

(a) The ailerons are power-operated by oil supplied under pressure from the aircraft hydraulic system. A booster jack of the servodyne type, consisting of an on/off valve, a control valve, a jack body and a piston is fitted close to each aileron. The control column is connected direct to the control valve, the piston rod is anchored to the aircraft structure and the jack body is connected to the control surface.



AILERON BOOSTER JACK OPERATION

(b) (i) When hydraulic pressure to the booster jacks is selected on, the pressure fluid is directed to the servodyne on/off valve which opens, compressing its return spring. With the control valve central (i.e. control column central) fluid is then passed to the ram side of the piston head (i.e. the left side, in the sketch), and the fluid on the cylinder side (i.e. the right) is isolated. The jack is thus locked hydraulically.

(ii) When the control valve is moved inwards, pressure fluid passes to both the ram and the cylinder sides of the piston head. Since the effective area of the cylinder side of the piston head is twice that of the ram side, the jack extends with an effort equivalent to the difference in pressure.

(iii) When the control valve is moved outwards, the cylinder side of the piston head is connected to exhaust and the ram side is connected to pressure. The jack then retracts with an effort equivalent to extension effort.

(c) If hydraulic pressure falls or is selected off, the spring in the on/off valve overcomes the hydraulic pressure and exhausts both sides of the jack piston to the return lines to the header tank. In manual, control surface movements are achieved by the control column pushing the control valve against its stop and then pushing manually the jack body to obtain control surface movement. The controls are heavier in manual due to (a) the artificial feel spring and (b) the necessity to move the jack and aileron manually.

18. **Controls and indicators**

(a) The aileron power system is controlled by the AILERON CONTROL master selector (65) in the centre of the cockpit floor. To select POWER, pull OUT the control and TURN right TO LOCK. To select MANUAL, push IN the control, TURN right to LOCK.

(b) Failure of the system hydraulic pressure is shown by an indicator on the forward end of the port shelf, which

shows white if hydraulic pressure in the system falls appreciably below normal.

In addition, failure of one or both hydraulic pumps is indicated by both flow failure warning lights coming on. The aileron power hydraulic accumulator provides sufficient reserve for a limited number of aileron movements before becoming exhausted.

19. **Aileron feel and trim devices**

(a) *Spring feel*

The piston rod of the servodyne unit is anchored to the aircraft structure and all air loads on the ailerons are resisted entirely by hydraulic jack effort. No air load is fed back to the control column. To provide a measure of control feel, a plain spring is fitted in the control circuit which gives an artificial stick force proportional to stick deflection but not to airspeed.

Rotation of the strut (23) applies trim when the ailerons are in power.

(b) *Trim tabs*

Each aileron has a servo-tab which operates during power operation to relieve loads on the booster jacks. When hydraulic pressure falls or is selected off, a pressure switch operates to enable the ailerons to be trimmed by means of an actuator connected to the port servo-tab. The spring-loaded trim switch (25) is on the port shelf. A trim cut-out switch (7), aft and outboard of the trim switch, may be used to isolate the actuator in case of a runaway trim motor. A warning light (19) on the port shelf, forward of the throttle box, lights up when the port aileron tab is out of the neutral position, provided MANUAL is selected. *The tab must be at neutral with the light out before power is engaged.* A circuit breaker (78) for the trim circuit is on the starboard shelf.

(c) *Aileron variable gearing*

(i) A gear-change device is fitted to the forward face of the control column, to enable the pilot to adjust the ratio of handgrip/aileron movement. It is controlled by a knob (29) below the hand-grip.

(ii) A stud moving in a slot between two marked positions, MANUAL (up) (low gear) and POWER

(down) (high gear), gives an indication of the selected position. Any intermediate position may be selected but no appreciable alteration to the gearing takes place until the stud is about $\frac{1}{3}$ of its travel towards MANUAL.

(iii) When the stud is at POWER, full aileron movement requires full stick deflection. This position is recommended for all normal flying, when in power. When the stud is at MANUAL, aileron movement is reduced to about 50 per cent. for full stick deflection. This helps to reduce stick forces when flying in manual. A mid-gear position is recommended when flying at high mach numbers with power on, since better lateral control is thus obtained; this is a preferable gear setting should inadvertent manual reversion occur.

OTHER AIRCRAFT CONTROLS

20. Elevator and rudder controls

(a) *Elevator*

The elevator is manually operated and has a servo-tab to assist the pilot and a trimming tab controlled by the hand-wheel (20) on the engine control box. The trim indicator (12) is on the rear face of the box.

(b) *Rudder*

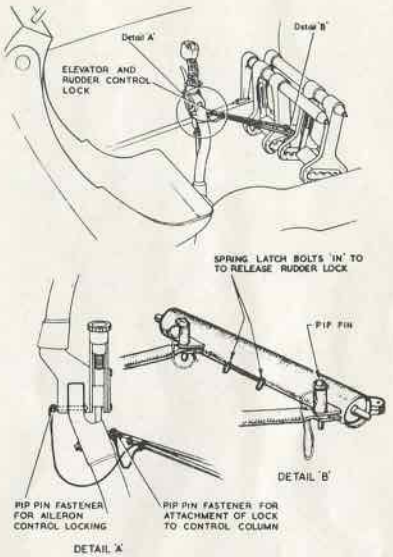
Each rudder has a ground adjustable anti-balance tab. The rudder pedals can be adjusted to suit the pilot's leg length by lifting them and then sliding them forward or aft into the required slot.

21. Flying controls locking gear

(a) *Internal*

A single triangular bar assembly secures the pedals and prevents fore and aft movement of the control column. The quick-release pin secured to this assembly is inserted through the hinge of the upper portion of the column to

prevent aileron movement. The spring bolts which lock the rudder pedals are released by pulling the two latch bolts towards each other. When not in use, the locking gear is folded and stowed inside the starboard ammunition door.



(b) *External*

Clamping blocks are provided for the ailerons. They must be removed before wing folding, before removing the internal locks and before engaging powered controls.

22. Undercarriage

(a) *Normal operation*

The undercarriage selector lever (34) is on the left of the instrument panel and is pulled *out and up* to select up. When selecting down, the lever must always be moved fully down into its slot. When the wheels are on the ground, the lever is locked in the down position by a solenoid-operated plunger.

(b) *Position indicator*

A standard undercarriage position indicator (32) is below the lever.

Indications are:—

Undercarriage locked up	.. ..	No lights
Undercarriage unlocked	.. ..	Three red lights
Undercarriage locked down	..	Three green lights

(c) *Emergency operation*

If the engine-driven hydraulic pumps fail and accumulator pressure is exhausted, the handpump (66) to the right of the pilot's seat can be used to operate the undercarriage. To prevent possible inadvertent dumping of hydraulic fluid through the flaps pipelines, it is recommended that the flaps selector lever is set to neutral *before* operating the undercarriage by handpump. Up to 115 strokes of the pump may be necessary to lower the undercarriage fully and lock it down.

(*d*) *Undercarriage emergency override*

The undercarriage can be retracted in emergency, when the aircraft is on the ground, by first operating the guarded switch (18) forward on the port shelf and then using the normal undercarriage selector.

NOTE.—Safety locks, each with a red flag, may be inserted in the radius rods of the main undercarriage struts. Stowage for these locks is not provided.

23. **Flaps**

(a) *Normal operation*

The flaps selector lever (11) is on the rear face of the engine control box. There are three positions on the selector lever quadrant. UP-neutral-DOWN. Any degree of flap movement may be obtained by selecting and then returning to neutral after the required position is reached. The lever should be returned to neutral after the flaps are fully down, if it is necessary in emergency to conserve accumulator pressure, but may be left in the up position when they are up.

(b) *Position indicator*

Twin flaps position indicators (33) are fitted at the left-hand side of the instrument panel, one for the port and one for the starboard flap. They are marked with the 30° and 45° positions.

(c) *Emergency operation*

The flaps may be operated by the handpump after normal selection, if the engine driven pumps fail and the main accumulator is exhausted. (See para. 2 (e).)

24. **Airbrakes**

(a) *Normal operation*

The airbrakes are operated by a lever (15) extending from the top of the engine control box. No intermediate settings are available.

(b) *Emergency operation*

The airbrakes cannot be operated in flight by the handpump.

25. **Arrester hook**

(a) *Normal operation*

The arrester hook is hydraulically operated and selected by a lever (26) on the rear face of the engine control box. The selector lever is retained by a catch in the up position. The hook is lowered by pressure from two damper/accumulators and by gravity. It is raised and held in the up position by hydraulic power.

(b) *Indicator*

A green light (24), forward of the lever, comes on when the hook is lowered.

(c) *Carrier/airfield switch and external light*

A CARRIER/AIRFIELD switch (80) on the starboard shelf modifies the operation of an amber light on the nose-wheel fairing. The switch has a guard and is normally set to CARRIER; provision is made for wire-locking the

switch in this position. When the switch is set to CARRIER, the light comes on when the wheels are locked down and the hook is extended. With the switch set to AIRFIELD, the light comes on when the undercarriage is locked down, even though the hook is retracted.
Mod. SV/RAN/37 introduces a light on the nose access door (port and starboard) in lieu of the light on the nosewheel fairing.

(d) *Hook emergency operation*
To lower the hook, if the hydraulic system fails, select down in the normal way and the hook will be lowered by power from the damper accumulators and by gravity. To raise the hook, select up and use the handpump.

26. **Wheel brakes**

The maxaret wheel brakes are operated by a lever, incorporating a parking catch, on the control column and for differential braking by use of the rudder bar. The available pressure in the system (2,500 lb./sq. in. max.) and at each wheel brake (1,500 ± 50 lb./sq. in.—copperplates; 1,750 ± 50 lb./sq. in.—steel plates) is indicated on the triple-reading pressure gauge (17) on the port shelf. This pressure allows several full applications of the brakes if the main system has failed, and, in this event, the pressure will fall to 1,400 lb./sq. in. as the brakes are used. At this point the accumulator will be fully discharged and the gauge reading will drop rapidly to zero. Pressure may, however, be restored by use of the handpump. The maxaret units permit the use of full braking without the possibility of wheel locking and consequent tyre damage. The units can only come into operation when the wheels are rotating. In no circumstances should the brakes be applied until after touch-down.

27. **Wing folding and spreading**

(a) The wings are folded and spread by hydraulic power direct from the engine-driven pumps. They may also be folded by operating the handpump, provided the by-pass valve is opened (see paragraph 2 (e)). They are automatically locked in the spread position by hydraulically operated bolts at the front and rear spar attachments. Selection is by means of a SPREAD/FOLD lever (1) to the rear of the cockpit port shelf. See also note para. 59(d).

(b) *Safety devices*

(i) *Folding*. The lever is positively held in the SPREAD position until a similar LOCKED/UNLOCKED lever (2) immediately outboard of the SPREAD/FOLD lever is moved to UNLOCKED. This action withdraws a *locking pin* manually, allowing the hydraulically operated wing bolts to move. It also mechanically raises and illuminates indicators which protrude from the wing top surface. The position of the four hydraulically operated wing bolts can be checked by means of two magnetic indicators (8) on the cockpit port shelf. Provided electrical power is available, these will show *white* when either of the two locking bolts on one side are not fully home.

(ii) *Spreading*. The LOCKED/UNLOCKED lever must not be moved to LOCKED until the wings are spread and the hydraulically operated locking bolts are fully home, with the appropriate cockpit indicators showing black.

NOTE.—The cockpit indicators will show white whenever there is an electrical power failure.

28. **R.A.T.O.G.**

Reserved

29. **Flight instruments**

(a) *A.S.I. and associated instruments*

(i) A pressure-head on the port tail fin provides pressure for the A.S.I., V.S.I. altimeter and machmeter.

(ii) The pressure-head is electrically heated and the controlling switch (54) is on the centre switch panel.

(b) *Turn-and-slip indicator*

The turn-and-slip indicator is electrically operated. Electrical failure is indicated by an OFF flag on the face of the instrument. If the main electrical system fails, the indicator may be operated by the emergency lamps battery, after putting on the guarded switch (69) below the instrument. The instrument will operate on the emergency battery for 90 minutes if the emergency lamps are not in use and for 45 minutes if they are.

(c) *Artificial horizon*

The artificial horizon operates whenever alternating current is available, provided that the flight instruments master switch (52) and both inverter circuit breakers (at 72) are on. It has a fast-erecting button and an OFF flag to indicate power failure. Mod. N.864 introduces a Mk. 4 artificial horizon, which is an improved version of the Mk. 3C. Mod./Sea Venom RAN/9 introduces a Mk. 4 artificial horizon, and Mod./Sea Venom RAN/22 introduces a Mk. 3D. These instruments are alternatives and both are improved versions of the Mk. 3C.

(d) *Mk. 4F gyro compass*

A Mk. 4F gyro compass unit is on the bottom centre of the instrument panel, the detector is in the starboard wing and the corrector control panel (89) is on the aft end of the starboard shelf. Alternating current is required to operate the system and the flight instruments master switch (52) and both the inverter circuit breakers (at 72) must be on.

(e) *E2A stand-by compass*

An E2A magnetic compass (36) is at the forward end of the canopy hatch centre beam (Mod. SV/RAN/38)

(f) *A.Y.F. radio altimeter*

The A.Y.F. indicator (31) is on the bottom left of the main instrument panel and incorporates its own power supply switch. It is modified to read 0-800 feet only.

(g) *Accelerometer*

The accelerometer (42) is fitted above the centre of the main instrument panel.

COCKPIT EQUIPMENT

30. **Access to cockpit**

The cockpit is reached by a retractable footstep on the port side of the fuselage, this footstep normally retracts as the weight of the foot is removed. Alternatively, the cockpit may be reached by a ladder, which can be locked in a ferrule on either side of the cockpit.

31. **Hood operation**

(a) *Opening the hood from outside*

The flush-fitted external release handle is housed centrally just aft of the hood. A pushbutton on the handle is pressed to make the handle spring out of its housing; the handle is then turned anti-clockwise through 90° to release the hood lock (some force may be necessary). The hood can then be raised by hand; an arrangement balances the hood in any position, making movement up or down easy. When fully open, it is locked by a spring-loaded catch acting on the hood strut.

NOTE.—To prevent damage to the hood locking mechanism, care must be exercised to avoid snatching when opening the hood in high winds.

(b) *Closing the hood from inside*

The spring-loaded catch on the hood strut is released by moving forward and upward the lever (55) marked HATCH STRUT RELEASE, at the aft end of the starboard D.V. panel. The hood may then be lowered by hand and locked when closed by pulling the large handle, at the top centre of the windscreen, back and up. When this is done, a locking catch, next to the internal handle, should snap forward onto the handle—if it does not, it should be pushed forward. The locking catch, when fully forward, inflates the hood seal in addition to preventing any inadvertent operation of the handle.

32. **Hood jettisoning**

(a) *Explosive jettisoning*

The hood may be jettisoned explosively by pulling up the handle (64) on the cockpit floor, forward and to the right of the pilot's seat. When the handle is pulled up, a trigger is operated by Bowden cable, a cartridge fired, and the hood jettisoned. The trigger is made inoperative by inserting a locking pin in a socket on the bulkhead behind the pilot's seat, to port of the hinge mechanism. The pin has a red pennant attached to it. When not in use, the pennant is stowed in a canvas bag behind the pilot's seat, on the cockpit port wall.

(b) The original provision for rear hinge release in manual hood jettisoning is no longer operable, as the control cannot be reached in the air. It is, however, retained for ground use. If the hood has to be jettisoned manually, the normal opening handle should be operated, care being taken to keep the hand unclenched.

(c) With the introduction of ejection seats, the action of hood jettisoning automatically operates the following:—

Removal of the sear pins from the ejection seats

Tilting forward of the observer's seat.

33. **Oxygen system**

(a) Oxygen is carried in two 750-litre cylinders in the ammunition bay. Mk. 17C, 17D or 17E demand regulators are fitted, one forthe pilot and one for the navigator.

(b) The pilot's regulator (44) is to the rear of the cockpit port shelf , the observer's (88) to the rear of the starboard shelf. Each regulator consists of an on/off valve which controls the flow of oxygen, an air dilution NORMAL-100 % OXYGEN switch, an emergency three-position switch and a combined flow and blinker unit. A contents gauge (50) is on the starboard instrument panel.

(c) Two magnetic indicators (43), one for the pilot and one for the observer, work the same way as the blinker unit, whenever electrical power is available. They show black when no oxygen is available.

(d) When the on/off valve is ON and the dilution switch is at NORMAL, an air/oxygen mixture is fed to the mask up to a height at which 100 % oxygen is automatically delivered. When the dilution switch is at 100 % OXYGEN, no air is added irrespective of the height. This position should be selected at all times.

The emergency switch, when moved to either right or left, admits oxygen under greater pressure. Normally it should be central, but should be offset if cabin pressure failure occurs.

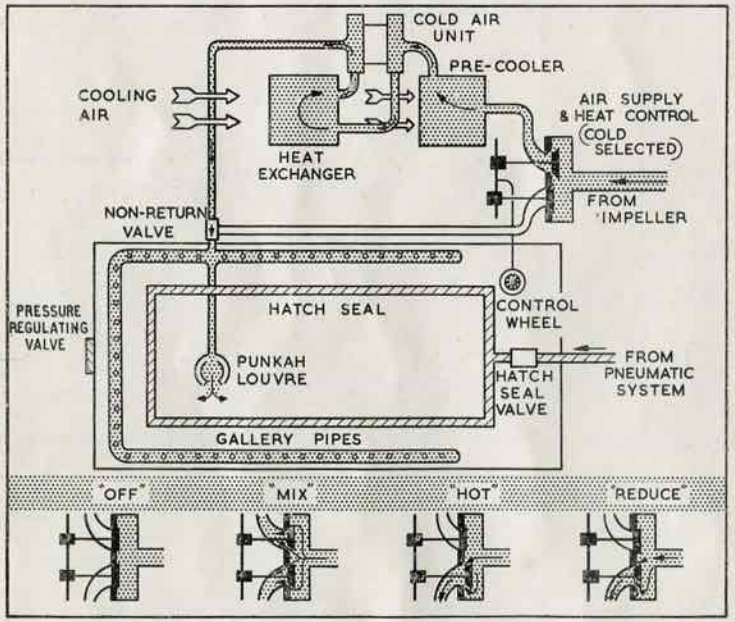
(e) The mask may be tested before flight by firmly pressing in the emergency switch, when in the central position. Oxygen is then supplied under pressure, the more firmly the switch is pressed the greater the pressure (up to five times that obtained with the switch in either side position). The mask can then be adjusted until no leaks are present.

(f) When flying solo, the pilot should ensure that the observer's regulator is switched OFF to avoid wastage of oxygen.

(g) An emergency oxygen bottle is incorporated in each ejection seat and is automatically brought into use when ejecting. It can be operated independently by pulling up the cord to the right of each seat.

34. Cockpit air conditioning

(a) Cockpit pressurising, heating, and cooling are controlled by movement of the wheel (27) on the port shelf. The wheel rotates through 270° and has five marked positions: OFF - COLD - MIX - HOT - REDUCE.



COCKPIT PRESSURIZATION AND HEATING

(b) *Pressure*

With the hood seal control on (i.e., with the hood handle locking catch in the forward position), and the wheel set other than OFF, the cockpit pressure is automatically controlled by a valve which allows a steady build-up of differential cockpit pressure above approximately 12,000 ft. until, at 30,000 ft., the full differential pressure is

reached. The cockpit pressure is indicated on an altimeter (68) at the lower portside of the instrument panel. A warning light (67), beside the cockpit altimeter, comes on when the cockpit altitude falls below the allowable minimum for a given true altitude. The table below shows the cockpit altitudes corresponding to the minimum pressures. When the control is at REDUCE the cockpit pressure will be reduced.

Actual altitude (ft)	Equivalent altitude (cockpit)	Approx. cockpit altitude at which light comes on
20,000	14,000	16,000
30,000	20,000	22,000
40,000	25,000	32,000
50,000	28,000	34,000

(c) Air for pressurising enters the cockpit through a louvre and also through holes in the gallery pipe for windscreen and hood de-misting. The amount of air passing to the windscreen can be controlled by adjusting the louvre.

35. Windscreen de-icing

The windscreen de-icing system is controlled by a hand-operated pump (28) on the port shelf. The pump handle is released by rotating it anti-clockwise. As the handle comes out under pressure the windscreen is sprayed. Pressure is raised again by pushing the handle in.

36. Direct-vision panel

A direct-vision panel is fitted in the port quarter of the front windscreen and is opened by turning a screw knob at the top. When the panel is open it lies at an angle across the top of the cockpit; in this position it presents a hazard to the pilot in a crash landing. It can, however, be removed and handed to the observer—no stowage is provided.

37. **Windscreen wiper**

The windscreen wiper is controlled by a knob (30) on the cockpit port shelf. It is turned anti-clockwise to on.

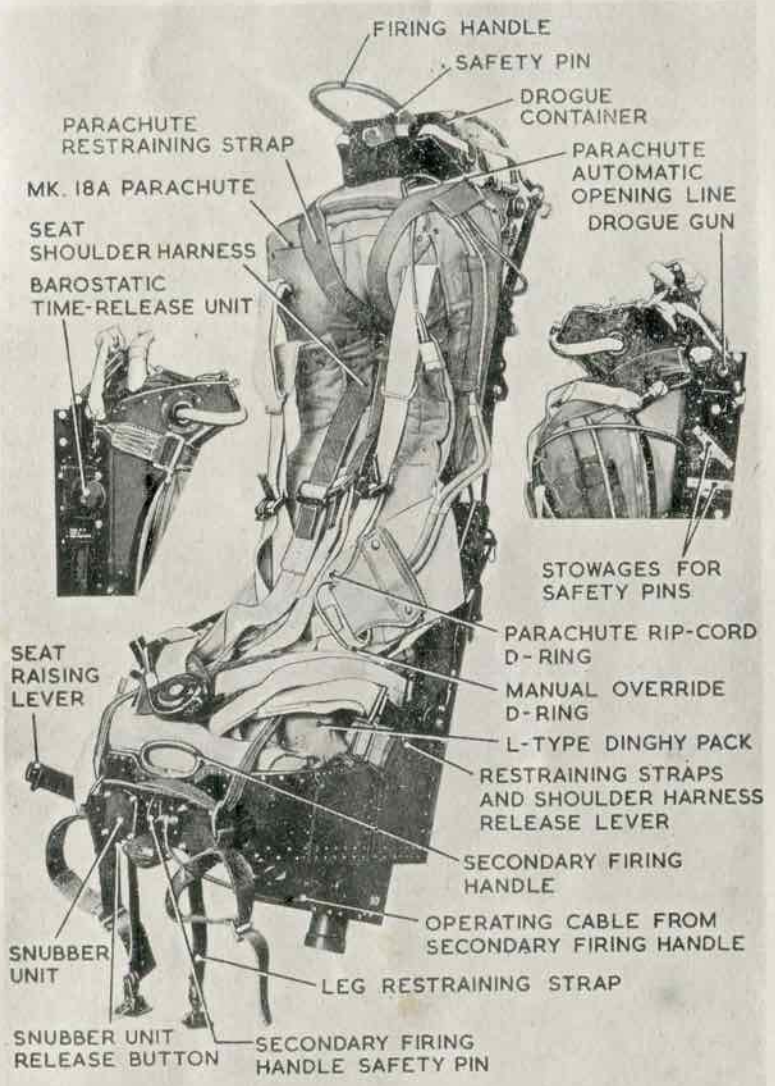
38. **Ejection seats**

WARNING.—The ejection seats are fitted with two firing handles, one in the normal position on the drogue box and the other on the front of the seat pan. The firing handles must always be locked against the possibility of accidental withdrawal whenever the aircraft is on the ground. The longer of the two safety pins should be inserted in the hole aft of the blind handle and the shorter in the hole below the seat handle. It is the occupant's responsibility to lock the firing handles after landing and to ensure that the pins are removed and stowed prior to take-off. All personnel must ensure that the firing handles are locked before entering the cockpit.

(a) Two Mk. 4A ejection seats are fitted, the pilot's being a Mk.4A-1 and the observer's a Mk.4A-2. The harness is of the Z type and the parachute is a Mk.18A in a horse-shoe pack. A modified N-type dinghy pack is stowed in the seat pan, with a Mk.4A emergency oxygen bottle in front of it, below a rubber cushion. Both these items are inside the parachute harness, which must always be tight in order to prevent the oxygen bottle coming out of its stowage during negative G conditions.

(b) (i) Leg-restraining cords are provided to ensure that the occupant's legs are drawn back and together automatically and restrained close to the seat pan during ejection, thus providing leg clearance and preventing the legs from being blown apart after ejection.

(ii) After connecting the dinghy pack to the life-jacket (ensuring that the lanyard passes outside the right leg), doing up the parachute harness straps and the seat harness lap straps, the cords should be fitted as follows:—



EJECTION SEAT MK. 4A

1. Secure the garters below the knees with the D-rings to the inside rear.

2. Pass the cord from the left snubber unit through the D-ring on the right leg and under the lap strap, then insert the right shoulder safety harness eye-piece through the loop in the end of the cord and secure the harness in the quick-release box. The other cord should be done up in a similar manner. It is important to remember to cross the cords before passing them through the D-rings, otherwise the legs will not be held together during ejection.

(iii) The restraining cords are fastened to the floor with a breakaway strength of 400 lb. The cords pass through snubbing units at the front of the seat-pan, which allow the cords to pass freely downwards through the unit but prevent them passing upwards unless the release button at the bottom of the unit is pressed.

(c) (i) The seat height may be adjusted by a lever on the starboard side of the seat. The control operates in the natural sense, after depressing the button at the top of the lever.

(ii) No safety harness releases are provided, and should the occupant wish to lean forward for any purpose, it is necessary to loosen the shoulder harness straps.

(d) The seat has duplex drogues and an 80ft. sec. gun. After pulling either firing handle the seat gun fires immediately and, after a ½-second delay, the drogue gun fires. A barostat-time control prevents separation from the seat unless it is below 10,000 feet. At this height, or if ejection takes place at a lower altitude, there is a 3-second delay, after which the blind is released, the seat harness released and the parachute opened and the seat falls away from the pilot.

NOTE.—Ejection cannot take place until the hood has been jettisoned, as jettisoning removes the sear-pin. (See para. 32 (c)).

(e) A manual override D-ring is fitted over the parachute rip-cord D-ring. If it is necessary to employ manual separation from the seat, this ring should be pulled first; this disconnects the parachute from the automatic opening line. After pulling this ring, the parachute restraining strap release lever on the port side of the seat should be pulled inwards and upwards; this releases the safety harness and the parachute

restraining straps.

(f) (i) The emergency oxygen tube and the operating cable are on the starboard side of the seat pan. The cable passes along the outside of the seat and through a fairlead to a clip on the floor. The emergency oxygen is thus automatically turned on during ejection or can be turned on manually by pulling the operating cord. When strapping in, care should be taken to ensure that the emergency oxygen supply pipe passes *under* the right shoulder strap of the safety harness.

(ii) The mic-tel quick-release socket is on the port side of the seat and is kept in position by tucking a loop of the cable under the parachute restraining strap.

(iii) The main oxygen supply comes through a P-clip on the starboard side of the seat and a clip on the starboard lap-strap. It has a quick-release connection. The oxygen mask tube should be fastened to the D-ring on the lifejacket.

(iv) Stowages for the firing handle safety pins are on the port side of the seat and consist of three spring-clips for each label. In addition, a spring-clip is incorporated in each label as a stowage for the pin itself. Post seat Mod. 410, the clip stowage is moved from the top of the seat (see illustration) to the top of the seat pan torsion box, behind the left elbow.

(g) The seats are linked with the hood jettison mechanism so that the action of jettisoning the hood withdraws the sear pins from the seat guns and tips the observer's seat forwards. Before flight, a check must be made to ensure that the sear pins are in position.

(h) Post seat Mod. 567, a G-stop is fitted to the barostat control of the ejection seat, to prevent the opening of the main parachute if the speed of the seat after ejection is too high for safe deployment. With this device fitted, the time delay is reduced from 3 seconds to 1½ seconds and ejection can be made from ground level upwards, *provided that the aircraft's flight path is horizontal and the speed is at least 90 knots*. If the aircraft is descending or nose-down, more altitude will be required. Runway ejections should not be made at speeds below 90 knots unless the circumstances of the emergency are such that ejection is the only reasonable solution.

39. Internal lighting

(a) *Transilluminated instrument panel*

The basic panel is covered with a sheet of transparent plastic, faced with black opaque plastic. Labelling is engraved through the black plastic. Suitably positioned red lights are built into the transparent panel, giving an even distribution of light over all instruments. The lighting is controlled by a knurled dimmer switch (5) marked INST PANEL LTS at the aft end of the port shelf.

(b) *Other lighting*

Pillar lighting and red flood lamps provide the remainder of the cockpit lighting and the lamps are controlled by two dimmers (3 and 4), on-off switches on the port shelf and a dimmer (92) on the starboard shelf.

(c) *Emergency lamps*

The two emergency lamps are controlled by a switch (59) on the starboard side of the main instrument panel. They are supplied by a 24-volt alkaline battery, which also provides the emergency supply for the turn and slip indicator.

40. External lighting

(a) A circuit breaker (at 72) on the starboard shelf, marked EXTL LTS, protects the circuit.

(b) *Navigation lights*

The navigation lights are controlled by OFF-STEADY-MORSE (96) and DIM-MORSE-BRIGHT (97) switches on the starboard shelf.

(c) *Downward identification light*

The downward identification light is controlled by a MORSE-STEADY switch (81) on the starboard shelf.

(d) *Landing lamp*

The landing lamp OFF-LOW-HIGH switch (94) is on the starboard shelf. After switching the lamp from OFF, there is a short delay before the light comes on, while the lamp extends. The lamp should not be extended at speeds above 175 knots.

RADIO AND RADAR

41. V.H.F. (A.R.I.5491)

(a) The V.H.F. installation, which provides airborne relay facilities, comprises two ten-channel sets, types T.R.1934

and T.R.1935, with a type 383 controller; whip aerials are on the starboard tail boom and under the port wing.

(b) The controller (63), which includes two channel selectors and a selector switch, is on the floor on the centre-line of the aircraft. The selector switch is marked RT1-DUAL-REL-RT2.

(c) The pilot's R/T-MIX-BEACon switch (79) and the observer's R/T TELS-BEACON switch (86) are on the starboard wall of the cockpit.

(d) The pilot's press-to-transmit button (14) is incorporated in the throttle lever and the observer's press-to-transmit switch (91) is on the starboard shelf. The observer's foot-operated muting switch (61) is on the cockpit floor.

(e) There is a quick-release mic-tel socket on the port side of each ejection seat.

42. Z.B.X. (A.R.I.5307)

The beacon receiver is behind the pilot and the controller (82) is on the starboard wall. Signals can only be received by the pilot if the R/T-MIX-BEACon switch is set to MIX or BEAC and by the observer if his R/T TELS-BEACON switch is at BEACON or if the pilot's switch is at MIX.

43. Intercomm.

Intercommunication is normally through a type A.1961 amplifier; this is controlled by the I/C ON/off switch (84) on the starboard wall. The NORMAL/EMERGENCY switch (85) should be at NORMAL. In emergency, one of the V.H.F. sets can be used for intercommunication by setting the NORMAL/EMERGENCY switch to EMERGENCY. When the switch is thus set all conversation will be broadcast if either press-to-transmit switch is operated. There is an external intercomm. plug behind a spring-loaded flap, outboard of the port wingfold.

44. **Green Salad (A.R.I.18049)**

(a) The indicator (35) is mounted on the GGS collimator platform and the control unit (119) on the right-hand instrument panel. A switch (60) adjacent to the indicator controls the indicator lighting.

(b) Power supplies for Green Salad are through the existing V.H.F. installation and the system works over the same band of frequencies.

(c) When the set is not in use, the selector switch should be set to NORMAL. For homing, the switch should be set to RT1 or RT2, whichever is selected on V.H.F. A sensitivity switch, marked MIN-SEN-MAX is also on the control unit.

45. **Air Interception (A.R.I. 5807)**

(a) The scanner, modulator, T.R. unit and power unit are in the nose of the aircraft, the C.R.T. indicator and control units are in front of the observer, whilst the radar inverter switches (75), and control panel (109) are located at the top of the starboard switch panel.

(b) The search radar uses approximately 140 amps, therefore the set should be switched off when at engine idling r.p.m., to avoid overloading the circuit; it should be switched off immediately in the event of electrical failure, to avoid draining the battery.

46. **I.F.F. Mk. 10 (A.R.I.5848)**

The control panel (90) and the master switch (71) are on the starboard shelf and the aerial switch (87), marked UPPER-LOWER-FLIGHT is on the starboard wall, next to the intercomm switches. The two aerials, of the shark's fin type, are on the nose of the aircraft, just forward of the windscreen, and below the fuselage. The

radar inverter switches must be on before A.C. power can be supplied.

ARMAMENT EQUIPMENT

47. **Gunsight**

(a) A gyro gunsight Mk. 5 is mounted above the instrument panel and is controlled by the GGS SUPPLY switch (102) on the instrument panel provided that the GUNSIGHT circuit breaker (93), on the starboard shelf, is in.

(b) The gunsight dimmer-selector control (49) is on the starboard control panel. Radar ranging is through the A.R.I. 5807, while the pilot has a further twistgrip control on the throttle lever. When radar ranging is in operation, the pilot's control must be kept to the minimum (200 yd.) position while executing any manoeuvres involving sharp turns but, when tracking smoothly, the grip should be moved forward to the maximum (800 yd.) position, thus enabling the sight to be radar-controlled whenever the target range drops below 800 yds.

(c) armament MASTER SWITCH (at 62) and PAIRS/SALVO switch are on the floor of the aircraft aft of the V.H.F. controller.

48. **Cameras**

G.45 Camera

A G.45 camera is pod-mounted under the port wing and is operated by either the camera button or the gun button, provided the camera master switch (at 95) is on. If the cine-camera is to be operated by the gun button the armament MASTER SWITCH (AT62) must first be set to GUNS. A SUNNY-CLOUDY aperture switch (AT95) is on the starboard shelf, next to the camera master switch.

49. **Guns**

Four 20 mm. Hispano Mk5* guns are installed, two on each side of the nose, and are fired electrically by the trigger on the control column, after the safety catch has been released and the MASTER SWITCH (at 62) below the instrument panel has been set to GUNS. It is possible to fire the guns when the aircraft is on the ground.

50. **Rockets**

(a) Rockets may be carried under the wings and are fired by a button on the control column, after the safety catch has been released and the master switch has been set to GUNS and ROCKETS. A PAIRS/SALVO switch (at 62) is adjacent to the master switch.

(b) The following rocket installations may be used:—

(i) Mk. 8 type 28 installation for 3 in. R.P's. with 25 lb., 60 lb. or flare heads.

(ii) Mk. 8 Type 28 installation with a Mk. 12 type 1 rocket launcher installation for 3 in. R.P's. with 12 lb., 18 lb. and 25 lb. heads.

(iii) 5 in. H.V.A.R. with 38 lb. and 52 lb. heads. Only one H.V.A.R. may be carried under each wing.

PART II

LIMITATIONS

NOTE.—The limitations quoted in Part II are mandatory and must never be exceeded. The contents of Parts III and IV are mainly advisory but instructions containing the word "must" are to be regarded as mandatory.

51. **Engine limitations—Ghost Mk. 104**

Power Rating	Time Limit	R.P.M.	J.P.T. (°C.)
Take-off and operational necessity	30 mins. (combined)	10,250*	760
Maximum continuous	Unrestricted	9,750	660
Approach idling	—	5,000 (min.)	—
Ground idling	Unrestricted	3,000±200	450 (max.)

* The maximum permissible r.p.m. are to be reduced to 10,100 above 25,000 ft. when climbing and above 35,000 ft. in level flight if Mod. 1175 is not incorporated. If Mod. 1175 is incorporated, r.p.m. are automatically reduced from the maximum at 25,000 ft. to approximately 10,050 at 45,000 ft.

Oil temperatures

Maximum	135°C.
Minimum for starting and opening up using oil OM-71 or OEP-71	–10°C.
Minimum for starting and opening up using oil OX-38	–40°C.

52. **Flying limitations**

The Sea Venom 53 is cleared for service use, ashore and afloat, by day and by night, in temperate and tropical climates, using AVTAG, AVTUR or AVCAT fuel. In emergency, and, provided that the aircraft is suitably modified, AVGAS may be used, subject to a maximum altitude of 10,000 feet.

(a) *Maximum speeds, clean aircraft*

(i) *Airspeed*	500 knots
(ii) *Mach number* (ailerons in power)	
Below 15,000 ft.	0.82M
Between 15,000 ft. and 25,000 ft.	0.83M
Above 25,000 ft.	The IMN at which the marked nose-up trim change starts.
Ailerons in manual	0.82M at all heights

(b) *Flying limitations when carrying R.P's.*

(i) *Airspeed*	500 knots
(ii) *Mach number* (ailerons in power)	
Below 15,000 ft.	0.80M
Between 15,000 ft and 25,000 ft.	0.81M
Above 25,000 ft.	0.83M
Ailerons in manual	0.80M at all heights
(iii) *Maximum angle of dive when firing*	
With 3″ R.P's.	90°
With 5″ R.P's.	45°
(iv) Maximum angle of climb when firing flare heads	Do not exceed 30° except for operational necessity 20°

(c)

Reserved

(d) *Maximum speeds for the operation of:—*

Flaps, between 0° and 30°	190 knots
Between 30° and fully down	170 knots
Undercarriage	220 knots*

The maximum speed for the operation of a service also applies to flight with the service in the extended position.

* The nose-wheel may not lower fully at speeds above 150 knots.

53. Weight and C.G. limitations

(a) *Weight limitations*

The following table shows the maximum permissible all-up weights and the approximate corresponding loading. (Fuel AVTUR, 8 lb./gall.)

Permitted Manoeuvres	Max. weight lb.	Approx. corresponding loading
Overload take-off and gentle manoeuvres	16,150	Two crew, full fuel, full ammunition, R.P.'s
Take-off and all forms of flying	15,400	Two crew, full fuel, full ammunition
Max. weight for overload non-arrested landing	14,950	Two crew, full internal fuel, full ammunition, R.P.'s
Max. weight for normal non-arrested landing	13,200	Two crew, 172 gallons fuel, full ammunition
Max. weight for normal arrested landing	13,000*	Two crew, 146 gallons fuel, full ammunition
Max. weight for emergency arrested landing	13,500	Two crew, 208 gallons fuel, full ammunition

* Refer to current orders for entry speeds in this condition.

NOTE.—Landing with fuel in the tip tanks must not be made except in an emergency.

(b) *C.G. limitations*

With ejection seats fitted, the C.G. limitations are as follows:—

Forward limit	2.5 ins. aft of datum
Aft limit (tip tanks full, ammo tanks full)	7.7 ins. aft of datum
Aft limit (tip tanks full, ammo tanks empty or ballasted)	9.7 ins. aft of datum
Aft limit (tip tanks empty, ammo tanks empty or ballasted)	7.7 ins. aft of datum

54. **Permanent limitations**

(a) *Practice spins* of up to two turns are permitted on clean aircraft.

(b) *Intentional manual reversion* must not be carried out at speeds above 0.82M. If automatic reversion occurs, speed must be reduced immediately to below 0.82M.

(c) *Flight without tip-tanks* is prohibited. The jettison valves must always be opened when fuel transfer from the tanks has been completed and at all times when the tip-tanks are empty.

(d) *An accelerometer reading* of $+5\frac{1}{2}$G must not be exceeded.

(e) Because of the small clearance on ejection, the maximum thigh length is 27 ins. for pilots and 25 ins. for observers.

55. **Temporary limitations**

Reserved

PART III
HANDLING

MANAGEMENT OF SYSTEMS

56. **Management of the fuel system**

(a) When the L.P. and H.P. fuel cocks are on, all fuel is fed automatically to the fuselage tank, first the tip tanks—by air pressure—and, when transfer from these is complete, from the internal wing tanks by gravity. The fuel booster-pump should be on at all times in the air. If it fails or is switched off, a magnetic indicator will show white; in normal flight, engine failure is unlikely to result but above 20,000 ft. full r.p.m. may be unobtainable and large fluctuations in r.p.m. may be experienced.

(b) The rate of fuel transfer should be sufficient to maintain the level in the fuselage tank to within 240-320 lb. (30-40 gallons) of fuel at all altitudes and engine powers. There is sufficient air pressure to effect fuel transfer from the tip tanks when the indicators on the instrument panel show black. They should show white when transfer is completed or when the transfer pressure is insufficient. As soon as tip tank transfer is complete, the jettison switch must be set to JETTISON.

NOTE.—1. In rapid descents it is usual for the indicators to show white intermittently *before* transfer is complete.

2. The jettison switch must be at JETTISON at all times when the tip-tanks are empty.

(c) Provided that all is clear astern, fuel may be jettisoned from the tip tanks at any time. It takes approximately one minute to jettison all fuel and there may be a slight nose-down trim change during the process. The jettison switch should be left at JETTISON until after landing.

(d) When descending rapidly from high altitudes, the total contents fuel gauge will under-read but should readjust itself shortly after resuming level flight.

(e) A negative G trap in the fuselage tank ensures sufficient fuel for about 10 seconds flight with negative G. Flight in attitudes near the vertical should also be restricted to 10 seconds for the same reason. If less than 480 lb. (60 gallons) remain, the aircraft should be restricted to normal flying attitudes only.

(f) Between 10 and 22 gallons of fuel (80-175 lb.) are unusable, the amount increasing as the tail-down attitude increases.

57. Engine handling

(a) Although the engine r.p.m. may be within limits before take-off, forward movement of the aircraft may result in a creep-back in r.p.m. of up to 150. This will not appreciably affect the take-off. Take-off should not be attempted if the r.p.m. on run-up are less than 10,150 or if, during take-off ground run, they fall below 10,050.

(b) During the climb, the r.p.m. show a marked tendency to increase above the limitations. Great care should be taken to avoid exceeding the r.p.m. limitations when operating at high altitude. When Ghost Mod. 1175 is incorporated, r.p.m. are automatically reduced with altitude.

(c) In flight, particularly at altitude, there may be a lag in engine response to throttle movement and/or an inability to obtain maximum r.p.m. Normal engine control can only be regained by reducing altitude.

(d) All throttle corrections in the air should be made slowly and smoothly, particularly at high altitudes or when increasing power from low engine settings.

(e) With variations in airspeed, the r.p.m. will alter from those set—particularly at high altitudes—and constant small throttle corrections are necessary. If at any time the jet pipe temperature or engine speed reaches the appropriate limitation, power must be reduced or airspeed increased.

(f)(i) The A.C.U. has been rendered inoperative on R.A.N engines and to avoid overfuelling and overheating throttle movements must be made carefully.

(ii) Whenever possible, and especially above 20,000 feet, engine accelerations should be so controlled that the j.p.t. does not exceed 760°C. In an emergency, *below* 20,000 *feet*, slam accelerations are permissible from 6,500 r.p.m.; they must not be attempted above 20,000 feet.

58. Management of the pressurising and de-misting systems

(a) The control wheel for regulating the supply and temperature of the pressurised air must be set to OFF, HOT or REDUCE when the aircraft is on the ground with the engine running, in order to avoid overheating the cold air unit. COLD or MIX must not be selected on the ground.

(b) Unless the cockpit is kept pressurised, severe internal misting and icing is likely to occur at high altitudes and on descending. Therefore, it is recommended that the cockpit is pressurised before take-off.

(c) Engine idling r.p.m. should normally be sufficient to maintain full cockpit pressure at any altitude. Misting may occur if power is low for long periods, due to the reduced supply of hot air available to the hood and windscreen through the gallery pipes. The supply may be increased by:—

(i) Partially closing the main louvre, thus diverting the supply to the gallery pipes.

(ii) Increasing engine r.p.m.

(d) If a reduction in cockpit temperature is desired at altitude, MIX is to be preferred to REDUCE, otherwise the reduced volume of air entering the cockpit may adversely affect the pressure differential.

(e) When descending rapidly the cockpit pressure warning light may come on temporarily.

59. Management of the wing fold mechanism

(a) To avoid damage to the wing lock mechanism, the WING LOCK lever must be moved *fully* into its UNLOCKED position before the WING FOLD lever is moved.

(b) The control column should be held central when spreading the wings.

(c) Severe stresses are placed on the wing fold mechanism when taxying with the wings in the folded position, especially if the tip tanks are full; the aircraft must be moved at slow walking pace over smooth surfaces only. Taxying with the wings folded must be kept to a minimum and should normally be avoided ashore.

(d) If, at any time, the full operation of the wing spread movement is arrested before the wing reaches approximately 45° past top dead centre, the fully spread condition must be completed before wing fold is selected.

STARTING, TAXYING AND TAKE-OFF

60. External checks

The outside of the aircraft should be systematically checked for obvious signs of damage, security of panels, filler caps, doors, wheel fairings, wing fold mechanism and tip tanks. The engine intakes and tank vents should be free of debris and the jet pipe should be checked for wrinkling and the turbine and compressor blades for damage. The screws on the fairings forward of the intake should be checked for security. Oleos should be checked for equal extension and the tyres for creep, excessive wear or cuts, and brake leads for damage. The pressure head cover, the undercarriage ground locks and the external locks for the control surfaces must be removed. The elevator trimmer tab position should be checked (with the elevator held central). Check that the hood external locking handle is flush and that the hood is prevented from accidental closing by the catch marked HATCH STRUT RELEASE beside the starboard D.V. panel.

NOTE.—Check the type of fuel used for refuelling and type of fuel for which the engine governor is set.

61. Cockpit checks

NOTE.—Switches are not always marked ON/OFF, but normally the ON position is fully forward or up.

Enter cockpit, remove safety pins from the seat firing handles (2 per seat) and from the emergency oxygen, strap into seat (see Part I, Para. 38) check hood/seat pin in place and check:—

Hood ground jettison lever	Fully aft
Hood jettison detonator safety pin	Remove and stow
Hood jettison lever (64)	Fully down
Armament switches	Safe or off
Undercarriage selector lever (34)	DOWN, handle pushed into slot
All circuit breakers (72), (78), (93)	In
Seat	Adjust. (Seat safety pins removed and stowed)
Rudder pedals	Adjust, equal both sides
Tip tank fuel jettison switch (9)	CLOSED (tip tanks full) JETTISON (tip tanks empty)
Hood	Locked closed (handle up, locking catch pushed fully forward to inflate seal)

NOTE.—When opening or closing the hood it is advisable to support it. This is *essential* in strong winds.

Brakes	On, pressure sufficient. Equal pressure at each wheel with rudder bar central
Wing fold levers (1), (2)	Corresponding to the position of the wings (up for spread). Levers locked in their gates. *Serious damage may occur to the wing locking mechanism unless this is so.*
Windscreen de-icing pump (28)	Plunger locked in
Windscreen wiper control (30)	OFF

Cockpit air conditioning control wheel (27)	OFF, HOT or REDUCE. (This prevents over-heating of the cooler unit)
Air brakes lever (15)	IN
H.P. cock lever (10)	OFF
L.P. cock lever (22)	ON (fully forward and up)
Elevator trimmer wheel (20)	Check operation, then set to neutral
Arrester hook lever (26)	UP, catch engaged (if it is not *fully* up the hook must be raised by handpump before starting, to avoid heat damage)
Undercarriage override retraction switch (18)	Off (guard in position)
Engine fire-extinguisher pushbutton (56)	Press test button to test light.
Oxygen regulators (44) (88)	ON. 100%. Reaching mask.
indicators (43) (107) annunciating.	blinkers and magnetic
	EMERGENCY switch central
	Observer's OFF and NORMAL if flying solo
Powered aileron selector (65)	Check full movement and leave at MANUAL

NOTE.—Unless an external source of electric power is available it is recommended that the starred electrically operated items below are not switched on until the engine is running and charging the battery adequately, i.e., above 4,000 r.p.m.

Switch on electric power. As this is done, check that the fuel transfer, fuel pressure and aileron power failure indicators change to white and the wing lock indicators remain white if the wings are folded or change to black if the wings are spread and the mechanical locks are home. Then continue with the following checks:—

Flaps selector (11)	Check operation of flaps by hydraulic handpump and return selector to UP

Aileron trimmer (25)	Check operation and then set to neutral. (Light (19) out)
Undercarriage indicator (32)	Three green lights. Test bulb changeover.
Fuel (57)	Contents, transfer indicators (40) white
Generator failure lights (37) (73)	On (four in number)
Hydraulic flow lights (47)	On (two in number)
*Intercomm. (84) (85)	ON and NORMAL
*V.H.F. (63)	Select channels
Flight instruments switch (52)	On Check standby inverter aurally and that artificial horizon erects. Check main inverter aurally and magnetic indicator (38) change by switching on INST INVR MAIN GROUND TEST switch (98) Check EMERGENCY TURN AND SLIP supply (69)
*Cockpit lighting (3) (4) (5) (92)	As required (check EMERGENCY LIGHTS (59).
Carrier/Airfield switch (80)	As required

62. **Checks before starting**

Battery master switch (77)	ON
Throttle (13)	Closed
L.P. cock (22)	ON
Fuel booster pump switch (53)	On (FUEL PRESSURE indicator (41) shows black)

Starter master switch (51)	On
H.P. cock (10)	Check re-light system aurally by pressing the button in the top of the H.P. cock with the cock in the ON position.

NOTE.—It is essential to switch on the booster pump at least 20 seconds before attempting to start the engine, as the spill flow fuel system depends on booster pump pressure for its self-priming characteristics.

63. **Starting the engine**

(a) (i) Turn on the H.P. cock and then press the starter pushbutton.

(ii) The r.p.m. will rise rapidly to approximately 1,500 r.p.m. and then drop to approximately 1,100-1,200 r.p.m., when light-up will occur. The r.p.m. will then rise again until idling speed is reached. If light-up occurs at r.p.m. below 1,100 excessive j.p.t. may occur, in which case the H.P. cock should be set OFF before the limits are reached.

(b) If the engine does not start correctly it will be in one of the following sets of circumstances. The pilot should carry out whichever instructions are applicable:—

(i) *Cartridge fails to fire*

If a cartridge does not fire, close the H.P. cock and, except in an emergency, wait at least one minute before re-opening it.

Should the first cartridge fail to fire, the starter pushbutton will be held electrically in the depressed position and will return to the starting position only at the end of the automatic starting sequence. The remaining cartridge may then be fired after reopening the H.P. cock.

(ii) *Engine fails to rotate*

If the engine does not rotate or does so at low r.p.m. and there is a heavy discharge of yellow smoke

from the starter exhaust for a period of approximately 10 seconds, the safety disc has probably blown. The H.P. cock should be closed and the cause of failure rectified before attempting a further start.

(iii) *Failure to light up*

If the starter accelerates the engine normally but the r.p.m. continue to drop below 1,100 without any indication of light-up, the H.P. cock must be closed before the r.p.m. have fallen below 1,000. If the engine is allowed to light up below this speed, there is a slight risk of damage to the tailplane from possible torching, and, in any event, the start will be slow and laboured, with a risk of exceeding the j.p.t. limitations. Also, if the r.p.m. are allowed to drop below 1,000 before closing the H.P. cock, a wet start is likely on the next attempt.

(c) Two successive failures to start indicate a fault which should be investigated before a further start is attempted.

(d) After failure to light up, surplus fuel must be allowed to drain from the jet pipe.

(e) The cartridge breeches should not be reloaded until they have cooled down; expended cartridges can be removed however, and the breeches left open to assist in cooling. The starter master switch must be off during reloading.

(f) To avoid difficulty in removal, expended cartridges should not be left in the breech for more than eight hours.

64. **Checks after starting**

Engine fire warning light	Out
Engine idling speed	3,000±200 r.p.m.
J.P.T.	Below 450°C. (idling max.)
Generator failure lights	Out at 3,500 r.p.m. (increase r.p.m. to above 4,000 to ensure an adequate charge rate)
Main inverter	Magnetic indicator black.

65. **Checks before taxying**

Hydraulics	Flow lights out
	Check operation of the air brakes

Flying controls	Select aileron in POWER—indicator black
	Full and correct movement
Flaps	Check operation against indicator
Wheel brakes	Pressure 2,500 $^{+0}_{-100}$ lb./sq. in.
Instruments	Check and set
Mk. 4F compass	Synchronise with standby compass (wings must be spread)

66. **Taxying**

Check there is equal braking effect in each wheel (see para. 26). The brakes are powerful and effective on dry surfaces. On wet or slippery surfaces, particularly flight decks, great care should be taken that the wheels do not lock.

67. **Checks before take-off**

(a) *Airfield*

Throttle	Adjust friction
Trimmers	All neutral
Aileron gear setting	POWER. Peg at the bottom of the quadrant
Airbrakes	IN
Wings	Spread and locked
	Indicators black
	External indicators flush with wing surface. Both levers in their gates in the fully aft position
	Wing fold doors closed

Fuel	H.P. and L.P. cocks fully on
	Contents
	Booster pump ON
	Fuel pressure indicator black
	Tip tank fuel jettison switch CLOSED. (JETTISON if tip tanks empty)
Flaps	30° down
Instruments	FLT INST switch on
	Artificial horizon erect
	Turn and slip functioning
	*Main inverter indicator black
	Pressure head heater on
	Check Mk. 4F compass with E2
Oxygen	ON. Blinkers and magnetic indicators annunciating
Hood	Shut and locked. Seal inflated
	Direct vision panel closed
	Cockpit pressure control OFF, HOT, or REDUCE
Harness	Tight and locked
Flying controls	Ailerons in POWER, warning indicator black

* If the main inverter indicator shows white, the spring-loaded INST INVR MAIN RESET GROUND switch should be tripped, when the indicator should change to black.

(b) *Catapult*

The following alterations and additions should be made to the check list in (a) above:—

Trimmers	**Elevator neutral**
Flaps	**45°**
Wheelbrakes	**Off**
Fast erection button on artificial horizon	**Press and release when ship steady and pitch zero (avoid exceeding the limitation)**

68. **Take-off**

NOTE.—The aircraft must not be flown if the static r.p.m. obtainable at full throttle are less than 10,150, or if r.p.m. on take-off fall below approximately 10,050.

(a) *Airfield*

(i) Line up with the nosewheel straight and apply the brakes. Open up smoothly to take-off power with the isolating switch OFF. When take-off r.p.m. are reached, put the isolating switch ON and release the brakes.

(ii) During the early stages of the take-off the rudder is ineffective and small amounts of brake must be used if it is necessary to correct the aircraft's heading. The tendency to wander from the take-off path is slight, however, even in strong crosswinds.

(iii) Between 90-100 knots, depending on the A.U.W. and C.G. position, raise and hold the nosewheel clear of the ground. A strong pull force is required initially.

(iv) The aircraft should be flown off at between 115 and 125 knots. It does not unstick cleanly and, though it may be pulled off at lower speeds, this may lead to temporary one-wing heaviness, particularly in crosswinds.

(v) When comfortably airborne, brake the wheels and retract the undercarriage. Then raise the flaps. There may be a small resultant nosedown trim change but normally the trim change due to flap retraction from 30° is counteracted by the nose-up trim change as the undercarriage retracts. The isolating switch should be moved to OFF before closing the throttle. Should the r.p.m. drop appreciably when the switch is set OFF, close the throttle, then set the switch ON. Even if the r.p.m. drop by the maximum amount caused by A.C.U. failure, combustion failure should not occur.

(vi) Set cockpit air conditioning as required and check that the wing tip tanks transfer indicators are black. Check engine and flight instruments.

(b) *Catapult*

(i) Grasp the control column and lock the right arm firmly. After indicating " Ready to go " with the left hand, grasp the throttle quadrant immediately behind the throttle lever, thus ensuring that the throttle cannot move back.

(ii) During the launch, there is a strong tendency for the stick to come back, which may be aggravated by the aircraft's aft C.G. position. *The stick must not be allowed to come back*, since, if this happens, considerable force will be needed to push it forward again. At 124–130 knots, start the climb-away and, once the climb is comfortably established, raise the undercarriage. At 150 knots, raise the flaps.

(iii) Immediately after the launch, at night or in I.M.C., refer to the artificial horizon, A.S.I. and altimeter. Disregard the indications of the V.S.I. during and for a few seconds immediately following the launch; a false indication of 1,000 ft./min. climb occurs during catapult acceleration, followed by a further false indication of 500 ft./min. descent.

HANDLING IN FLIGHT

69. Climbing

(a) After take-off the aircraft may be allowed to accelerate to the recommended speed while climbing, provided that a speed of 325 knots is reached by 5,000 ft.

(b) (i) Climb at 10,250 r.p.m., reducing to 10,100 r.p.m. above 25,000 ft. If Mod. 1175 has been embodied, the climb can be made at full throttle throughout, the r.p.m. being automatically reduced from 10,250 at 25,000 ft. to 10,050 at 45,000 ft. and above.

(ii) The speeds for optimum rate climb for a clean aircraft are:—

Altitude	*Knots*	*Mach No.*
S.L.	325	—
10,000 ft.	295	—
20,000 ft.	265	0.59
30,000 ft.	215	0.59
35,000 ft.	200	0.61
40,000 ft.	185	0.62

(iii) For operational climb, the following speeds are recommended:—

20,000 ft.	0.60M.
30,000 ft.	0.65M.
40,000 ft.	0.70M.

(iv) If speeds are allowed to drop below those quoted in (b) (ii), especially at high altitude, the rate of climb will suffer.

(c) During the time that fuel is being used from the aft compartment of the tip tanks, the C.G. will move forward fairly fast and small amounts of nose-up trim will be required to maintain climbing speed.

70. General flying

(a) *Flying controls*

(i) *Elevator.* The elevator is light and effective at all speeds up to 0.81M. Above about 0.81M both the

elevator and trimmer become progressively less effective, and by 0.84M full use of the elevator or trimmer has little effect. The elevator trimmer setting should not be altered in this region of reduced control due to the large changes of trim which may occur when speed is eventually reduced and the trimmer re-asserts itself. It is very powerful at high indicated airspeeds and must be used with care. (See para. 75.)

(ii) *Ailerons in POWER.* The powered ailerons make the aircraft light and pleasant to control laterally. As artificial feel is provided by a spring strut in the aileron circuit, the force required varies with aileron deflection and not with speed. At indicated speeds above 375 knots the power control stalls progressively so that, although the initial response is immediate, the rate of roll is limited by the power control stall restricting the amount of aileron applied. For general flying in power the variable gear mechanism should be set to POWER (i.e., peg at the botton of the quadrant); this gives full aileron movement for full stick movement. When flying at high Mach numbers or when climbing at high altitudes, however, a mid-gear position is recommended as this appears to lead to reduced Dutch rolling and at the same time is a preferable gear in case of inadvertent reversion to manual control. (See para. 88.)

(iii) *Rudder.* The rudder forces are moderate at low speed and increase with speed. Directional control in all normal conditions of flight is, however, adequate.

(iv) *Airbrakes.* Use of the airbrakes causes mild buffet and small aileron oscillations at speeds above about 150 knots. They are moderately effective at speeds above 250 knots. Below this speed they become progressively less effective and have no noticeable effect below 150 knots. There may be some small longitudinal oscillation of the aircraft as they are selected but changes of trim at all speeds are small.

(b) *Changes of trim*

Flaps down—30°	Slight nose-down
Flaps 30° to fully down	Slight nose-up
Undercarriage down	Slight nose-up
Hook	Negligible
Increase of power	Nose-up

71. Manoeuvrability

The maximum rate of turn can be achieved just before the onset of buffet and the maximum rate of roll at about 310 knots or 0.8M whichever is less.

72. Flying at reduced speed

(a) Reduce speed to 160 knots. If the flaps are lowered to 30°, speed may be further reduced to 130 knots (140 knots with full fuel).

(b) In conditions of severe icing, the direct vision window may be opened at speeds below 240 knots, but it is not effective in increasing the view straight ahead. The panel should then be removed entirely and handed to the observer, there being no stowage.

(c) *Use of the windscreen wiper.* This should on no account be used on a dry windscreen. If the wiper fails to start, application of slight yaw may suffice to assist the first movement of the blade.

73. Flying in conditions of severe turbulence

(a) There is normally considerable wing flexing with and without fuel in the tip tanks; this is particularly apparent when flying in turbulent conditions.

(b) Speeds should, if possible, be kept within the following band:—

(i) Up to 15,000 feet — 300-360 knots

(ii) Above 15,000 feet

Upper limit	M=0.72
Lower limit	300 knots at 15,000 feet reducing to 205 knots at 40,000 feet.

It should be noted that, even within this speed band, control may be marginal in severe turbulence above 30,000 feet.

74. Stalling

(a) Stalling speeds at the same weight may vary considerably between one stall and another and between aircraft, depending mainly on the technique used.

(b) On some aircraft stall speeds under *approach* conditions may occur above those of engine-off stalls; this may be due to a change in the airflow characteristics as power is applied. Normally, however, these speeds are approximately the same, and may even be slightly lower under *full power* conditions.

(c) At the lowest speeds obtained, there may be some A.S.I. fluctuation at the stall.

(d) The approximate stalling speeds in knots, engine off, are as follows:—

Loading	U/C and flaps up	U/C and flaps fully down
1 crew, 800 lb. fuel (100 gallons)	115	100
2 crew, full ammunition, 800 lb. fuel (100 gallons)	118	105
2 crew, full ammunition, full internal fuel (maximum landing weight)	125	110

(e) (i) At all weights, with flaps down, there is little warning of the stall.

(ii) Under take-off conditions, with full power, the stall is usually accompanied by a starboard wing drop, which may become severe if the stick is held back. Recovery from the stall is immediate if the stick is pushed forward, though this may require considerable force after a catapult launch. If a wing-drop develops, full opposite rudder is very effective in raising the wing. Care must be taken not to snatch at the elevator control, as a G stall can easily be induced with only a light pull force.

(iii) Under other conditions, the stall usually occurs with mild buffet and there may be a tendency for either wing to drop gently. If full aileron is used to raise it, the stall of that wing may be completed but, if small aileron angles are used, the wing drop can be controlled. Full opposite rudder can be used to correct yaw when it occurs. There is no tendency to spin, nor is there a positive nose-drop at the stall. Recovery is straightforward and is effective immediately stick pressure is released but, unless full power is used, there will be a considerable loss of height.

(f) Use of flap also causes buffet which masks any prestall buffet that may be present.

(g) With flaps up, a strong pull force is required to hold the nose up as the stall is approached.

(h) Airbrakes do not alter the stall speed significantly, but may lead to slight aileron buffet and wing heaviness on one side; this first becomes apparent some 5-10 knots above the stall.

(j) If either or both wing fold doors are open on one side, wing heaviness will occur some 10 knots above the stall, and the stall of that wing occurs 5 knots earlier.

(k) *G stalling*

The onset of the stall is preceded by slight buffet and a possible increase in aerodynamic noise. With further backward stick movement, either wing may show a tendency to drop and, at the same time, the elevator pull force will lighten. Recovery is immediate on releasing the stick. At low airspeeds, with the C.G. near its aft limit, the aircraft is very easy to G stall with only a light pull-force. Care must therefore be used when climbing away from a catapult launch.

75. High speed flying

NOTE.—1. The airspeed limitation, in conjunction with the maximum of +5½G (accelerometer reading), is laid down in para. 52 and must not be exceeded for structural reasons.

2. The characteristics described below may be experienced at higher or lower mach numbers than those stated and may be more pronounced on some aircraft than others, whilst actual characteristics may vary between aircraft.

3. The elevator trimmer may be used with care, up to the area of reduced control. If nose-down trim is used during acceleration, then nose-up trim will be required during deceleration, otherwise strong elevator pull forces will be required to maintain level flight.

(a) *Ailerons in power*

(i) *Above* 25,000 *ft., aircraft trimmed at* 0.78M. At about 0.78M a slight nose-down trim change is usually encountered, increasing to moderate nose-down at 0.82M and returning to the trimmed state

momentarily about 0.84 to 0.85M. At about 0.86M a nose-up trim change usually commences which increases with Mach number. The elevator becomes very heavy above 0.81M. Vibration and buffeting may occur above 0.82M, whilst either wing may heavy up at about 0.87M. At speeds in excess of this, severe lateral rocking may occur and lead to ultimate loss of control.

(ii) As height is reduced below 25,000 ft., the nose-up trim change becomes very strong and the pilot may have to use both hands to hold the aircraft in the dive.

(b) *Ailerons in manual* (*see para* 88)

(i) Aileron stick forces are very high but assistance can be obtained from the trimming tab.

The operation of this tab is *fierce* and it should be used with care. *In the event of a runaway tab to full travel, it is unlikely that the aircraft could be held laterally level in manual at speeds in excess of* 240 *knots.*

(ii) The free stick movement which is experienced in manual, particularly at high Mach number, is associated with the free movement of the booster valves and is fundamental in the system.

WARNING.—Intentional reversion to manual, or flight with aileron power off at speeds in excess of 0.82M. is prohibited. In the event of warning of hydraulic failure at higher speed, speed should be reduced below 0.82M. as soon as possible and MANUAL aileron gear selected (i.e., peg in the top position). Reversion to manual at Mach numbers in excess of 0.82 will probably induce severe aileron "flap" and wing shaking. *This should not be allowed to persist.* It is unlikely that anything but mild wing dropping can be held with ailerons in manual, whilst the nose-up pitch may occur at a lower Mach number and be much stronger than with the ailerons in power.

(iii) Recovery in all cases should be initiated by throttling back and extending the airbrakes.

76. **Aerobatics and spinning**

(a) *Aerobatics*

(i) The aircraft is fully aerobatic with tip tanks, whether full or empty.

(ii) The following are the recommended minimum speeds, in knots, for aerobatics, until experience is gained:—

Roll	270
Loop	370
Roll off	370
Vertical roll	400 plus

(b) *Spinning*

(i) The nature of the spin is unusual in that the aircraft apparently performs a series of rolls along an axis which, in the first two turns, is only slightly inclined to the horizontal. (If the spins were continued indefinitely the axis would approach the vertical).

(ii) Care should be taken to keep the ailerons central for the initial stages of recovery. In-spin (pro-spin) aileron may delay or, if large amounts are applied, possibly prevent recovery.

(iii) Due to (i) above it is possible for rotation to cease with the aircraft in an inverted position. Inappropriate use of the controls may then possibly result in an inverted spin.

(iv) The elevator should not be trimmed below 170 knots when spinning from turning flight, as otherwise very heavy stick loads may be encountered, opposing any attempted forward motion of the stick to effect recovery.

(v) *Recovery from a spin*

With ailerons central, apply full opposite rudder and ease the stick forward (i.e. standard recovery action). As soon as rotation ceases, centralise the rudders. If recovery is unduly delayed ensure that the stick is laterally central. If difficulty is still experienced pull the stick right back and apply a little out-spin (anti-spin) aileron and move the stick forward in this displaced position. If rotation ceases with the aircraft inverted, forward movement of the stick should not be continued beyond the central position until the aircraft has been rolled out. The aircraft should not be pulled through from the inverted position due to the great height loss (and the rapid increase in Mach number at altitude) which will result.

77. **Descents**

(a) *Descents with airbrakes IN*

A speed of 0.67M. should be maintained in the descent to 25,000 ft. and 270 knots below 25,000 ft., with the engine set as near as possible to 6,500 r.p.m. The descent should be started at a point which will ensure that 680 lb. (85 gallons) remain at circuit height. This allows for 15 to 20 minutes loiter at sea level at about 160 knots and a safe margin for joining the circuit and one overshoot and landing, plus 120-175 lb. (15-22 gallons) allowance for unusable fuel.

(b) *Descent with airbrakes OUT*

An alternative method is to descend as in (a) above, but with the airbrakes OUT.

CIRCUIT PROCEDURE AND LANDING

78. **Checks before landing**

Airbrakes	IN

Arrester hook	As required. (Check hook light comes on if hook has been selected down).
Undercarriage	Locked down. Selector lever in slot. Three green lights
Brakes	Check pressures — OFF
Fuel	Contents
Flaps	Fully down on final approach
Harness	Tight and locked

79. **Approach and landing**

(a) *Airfield*

(i) Reduce speed below 220 knots before lowering the undercarriage and to below 190 knots before lowering the flaps to 30°. The nosewheel may not lock down until speed has been reduced to 150 knots.

(ii) The turn on to the final approach should be made at 130-140 knots and full flap selected on the final approach. The runway threshold should be crossed at 110-120 knots, depending on the weight. At speeds below 110 knots the drag characteristics are such that if a rate of sink is allowed to develop a large r.p.m. increase is required to check it. *To ensure prompt and even response to throttle opening, it is advisable to keep the r.p.m. above 7,000 until the decision to land has been made.*

(iii) The nosewheel cannot be held off the runway after landing when the speed has fallen below 90 knots.

(iv) *Use of maxaret brakes*

These should be used in the same way as normal hydraulic brakes. The maxaret units are fitted to permit the use of full braking *when necessary* without danger of wheel locking with subsequent tyre damage. The units can come into operation only when the wheels are rotating; in no circumstances should the brakes be applied before touch-down. Intermittent manual operation of the brakes during a landing run is not recommended as this involves

unnecessary wastage of brake pressure. When the units are in operation and violent oscillation of the triple pressure gauge needles occurs, it is a sign that too high a pressure has been selected for the runway conditions prevailing and that the wheels would lock if no maxaret units were fitted. Nothing is to be gained by applying such pressures; maximum retardation is obtained by applying sufficient brake pressure to cause only occasional operation of the units.

(b) *Carrier approach and landing*

(i) Reduce speed, carry out the pre-landing checks.

(ii) The turn from the downwind leg to the final approach should be made at 125 knots, where speed should be reduced to 110-114 knots, depending on loading and weather conditions.

Reserved

(d) *Carrier touch-and-go landings*

The following procedure must be observed:—

(i) Immediately after touch-down open up smoothly and quickly to full power.

(ii) Before reaching the catapult ramp, ease the nosewheel off the deck to reduce the shock load on the main oleos when riding up the ramp.

NOTE.—Care must be taken to avoid raising the nosewheel too high and thus increasing the drag and/or striking the tailbooms on the deck.

80. **Instrument approach**

The following speeds and approximate power and flap settings are recommended for use during instrument approaches, with undercarriage down. The figures apply with wing tip tanks empty.

	R.p.m.	Flaps	Airspeed (Knots)
Downwind	8,000	0	140
Base Leg	8,000	¼	135
Glide Path	8,000	¾	130

When the runway comes into view, flaps should be lowered fully and airspeed reduced to 115 knots.

81. **Flapless landing**

(a) The turn on to the final approach should be made at 145 knots. A long flat approach requiring little power

should be made and the runway threshold crossed at 125 knots.

(b) Owing to the difficulty of losing speed, it is recommended that:—

(i) The aircraft be at its minimum all-up weight, and

(ii) The speed be reduced to 125 knots early on the approach, to avoid the possibility of crossing the threshold too fast.

82. Going round again

NOTE.—With full flap and undercarriage down, it is easy to go round again from ground level using 9,000 r.p.m.; using this technique, there is less vibration before flaps are raised and the stick is in a more central position. Full power may be preferred, however, especially at night, in order to clear the ground quickly and to raise the undercarriage and flaps safely. With full power the stick may be near its forward limit.

(a) Increase power as required.

(b) Raise the undercarriage, if so desired.

(c) Raise the flaps. It is recommended that the flaps are raised by stages, especially at night, as slight sink occurs and the rearward displacement of the control column as the flaps retract is considerable.

83. Checks after landing

(a) Flaps	UP
Brakes	Pressure sufficient for taxying
Cockpit pressure control	OFF
Pressure head heater	Off
Radar	Off

(b) *Stopping the engine*

Lower the flaps, returning the lever to the neutral position to conserve accumulator pressure. Then close the throttle fully, wait half a minute for engine temperatures to stabilise, and stop the engine by closing the H.P. cock. Then check:—

Radio	OFF
All other switches	Off
Battery master switch	BATTERY ISOLATED (see NOTE below)
Chocks	In position
Brakes	Off
Wings	Wing-fold selector lever corresponding to position of wings. Wing-fold struts in place.
	External locks in position
Hood jettison detonator	Pin in position
Seats	Safety pins in position (2 per seat)
L.P. cock	OFF when engine has stopped turning. (This will prevent seepage of fuel to the combustion chambers and subsequent hot starts.)

NOTE.—The battery master switch must not be moved to BATTERY ISOLATED until the generator power failure light has come on and the engine has stopped, otherwise the electrical power system may be damaged.

PART IV
EMERGENCY HANDLING

84. Action in the event of a tip tank failing to transfer or jettison fuel

In case of unsatisfactory transfer of one tip tank, denoted by one indicator showing white well before the other, every effort should be made to jettison the fuel before landing. It may, however, be impossible to jettison the contents of the faulty tank due to lack of air pressure. In such cases the jettison switch should be left at JETTISON and, if time is available, the tank partially emptied by alternately climbing and diving the aircraft. It is also possible that about the first quarter of the tip tank fuel will transfer by gravity.

85. Landing with a full tip tank on one side

(a) *Ailerons in power*

With the ailerons in power, a normal approach and landing can be made, though a 5 knot increase in speed is recommended; a considerable rudder force may be required. The limitations set out in para. 53 (a) should be borne in mind..

(b) *Ailerons in manual*

The recommended minimum speed for a straight approach is 130 knots with a full tip tank on one side and an empty one on the other; considerable aileron and rudder

forces will be required. The aileron gear should be set *not less* than 2/3 down. Approaches and overshoots down to speeds of 120 knots have been carried out.

86. Engine failure and relighting in flight

(a) *Mechanical failure*

If the engine fails in flight due to obvious mechanical causes, immediately turn off the L.P. and H.P. cocks, switch off the booster pump and all non-essential electrical services.

(b) *Flame-out*

NOTE.—If practicable, all electrical services except those which are immediately essential should be switched off in order to obtain maximum output from the batteries.

(i) Close the H.P. cock immediately. Keep the booster pump on.

(ii) Wait, if possible, for one minute, to allow excess fuel to drain from the jet pipe before proceeding with the drill.

(iii) Relighting may be accomplished at altitudes up to 40,000 ft. but it is more certain at 30,000 ft. and below.

(iv) Set the throttle closed.

(v) Maintain forward speed between 180 and 250 knots, and a windmilling speed of not more than 1,800 r.p.m

(vi) Press the relight button and put the H.P. cock quickly to the fully open position, keeping the relight button pressed for 20-25 seconds.

(c) If the engine has not relit within 20-25 seconds of having opened the H.P. cock, close the cock again and wait if possible for one minute before repeating the cycle of operations.

87. **Action in the event of engine fire**

(a) Should the fire warning light come on, close the throttle immediately. If the light goes out within 5 seconds of closing the throttle, a fractured air casing, as distinct from fire, is indicated. It is safe to use the engine in this condition but a landing should be made as soon as practicable. Reduced power should be used but unless the power required is small, the light will probably come on again. It is advisable, therefore, to throttle back every 5 minutes to check that the light goes out and so ensure that a fire has not started.

(b) If the light does not go out after closing the throttle, proceed as follows:—

(i) Close the L.P. and H.P. cocks.

(ii) Switch off the booster pump.

(iii) Reduce the airspeed as low as practicable and turn OFF the cockpit pressure before operating the extinguisher. If the fire is extinguished, the fire warning light should go out.

(iv) Any attempt to relight the engine may result in a further outbreak of fire which will be uncontrollable, since the extinguisher cannot be used again.

WARNING.—Fire in the engine bay may render the flying controls and pressure instruments useless, necessitating abandoning the aircraft immediately.

88. **Flying in manual control** (see para. 75 (b) (ii) WARNING)

(a) For training purposes, manual control can be selected but if hydraulic pressure fails, the aileron control will revert to manual automatically.

NOTE.—Although flying in manual control presents no difficulties, it must be remembered that it is a "get you home" device and not an alternative system.

(b) When manual reversion occurs there is a slight change in longitudinal trim, due to aileron upfloat.

(c) Aileron forces in manual are very heavy, therefore MANUAL should be selected on the variable gear aileron control which, though decreasing aileron movement, will ease the stick force. The free stick movement which is experienced in manual, particularly at high Mach numbers, is due to the free movement of the booster valve and is fundamental in the system.

(d) The use of the aileron trimmer to assist in manoeuvring the aircraft is not recommended, as the action of the trimmer is so far in advance of the aircraft's response that it is impossible to check the aircraft laterally when required. In the event of a runaway tab it can be switched off by means of the trim cut-out switch.

(e) Landing in manual control presents no difficulty but, due to high aileron stick forces, a slightly longer approach is recommended.

89. **Hydraulic failure**

NOTE.—It is possible that the hydraulic services will operate quite normally after the flow failure lights have come on.

(a) In the event of hydraulic failure, the flap lever should be set to neutral immediately. Pressure is available from three hydraulic accumulators.

(i) *Main accumulator.* All services are connected to the main accumulator and it will provide one *one-way* operation of the undercarriage and flaps or extend the airbrakes and *partially* retract them.

(ii) *Brake accumulator.* This should provide sufficient brake pressure for landing; it is the only accumulator which can be charged by the hand pump.

(iii) *Aileron and brake accumulator.* This provides a maximum of three full aileron reversals.

(b) (i) To conserve pressure in the main accumulator for lowering the undercarriage and flaps, manual aileron control should be selected (see para. 88). Under no circumstances should the airbrakes be used as they cannot be operated by the hand pump in flight (see sub-para. (a) (i) above).

(ii) If a fast descent from high altitude is required, the following procedure is recommended:—
Reduce speed below 220 knots.
Lower the undercarriage (see para. 90).
Descend at not more than 220 knots.

(iii) On a G.C.A., full flap should be lowered before the glide path is reached.

(iv) If insufficient accumulator pressure is available for braking, pressure should be built up by the hand-pump before landing. If an observer is carried, the handpump can be operated during the landing run. To conserve pressure, do not operate the brake lever on the checks for landing. On landing, apply pressure in such a way that the maxarets do not operate, i.e., increase pressure inversely with speed and avoid differential braking as much as possible. *An excessive loss in pressure will occur if the brake lever is released once it has been applied.*

(v) If total hydraulic failure occurs, a belly landing will be inevitable. For deck landing, see para 97A.

90. **Emergency operation of the undercarriage**

(a) In the event of hydraulic failure and no pressure being available in the main accumulator, the undercarriage, having been selected, can be operated by using the hand pump. Up to 115 strokes of the hand pump may be necessary to lock the undercarriage down.

(b) If the hand pump has to be used, the hook selector should be moved to DOWN and the flap lever to neutral before operating it—this will minimise the loss of fluid should a pipe line be fractured.

(c) The undercarriage can be selected up on the ground if the override switch is set ON and the selector lever raised. This is not possible if total electrical failure has occurred.

91. **Emergency operation of the flaps**

In emergency, the flaps, having been selected, can be operated by using the hand pump. If a leak in the system

is suspected the hook should be selected DOWN first if a carrier landing or landing on an airfield equipped with arrestor gear is to be made.

92. **Generator failure**

(a) If one generator fails, the output of the other, even at idling r.p.m., will be sufficient to keep the battery charged, using all the normal services.

(b) In the event of total electrical failure, the alkaline battery will operate the cockpit emergency lamps and the turn-and-slip indicator. If the battery is fully charged, the turn-and-slip indicator will work for approximately 90 minutes; if both services are being operated, its life is reduced to about 45 minutes.

(c) If both generators fail, the main battery endurance will be approximately as follows:—

All services on	Less than 5 minutes
Radar switched off *immediately*, other services on	10 minutes
VHF and instruments only	20 minutes

93. **Loss of cockpit pressure**

If cockpit pressure is lost above 40,000 ft., the following procedure should be carried out:—

(a) Both crew members must deflect the emergency oxygen switches on their regulators to either right or left.

(b) Descend below 30,000 ft., check that 100% OXYGEN is selected and switch off emergency oxygen.

94. **Hood jettisoning**

(a) If possible, reduce speed to between 110 and 285 knots and lower the seat fully. Both occupants should lower their heads before the jettison handle is pulled. The aircraft should be in straight unyawed flight.

(b) Pull the jettison handle on the cockpit floor. This will release the hood at the rear end and at the same time fire the cartridge which blows it off. The action of jettisoning the hood will also remove the sear pins from the seat guns and tip the observer's seat forward.

(c) If the jettison gun does not fire, the hood can be jettisoned manually by operating the normal opening handle. The rear hinge release cannot be reached when the crew are strapped in their seats and use of the normal handle only may result in damage to the elevators. Manual jettison should therefore only be used when it is intended to eject.

NOTE.—When jettisoning the hood manually, care must be taken to keep the hand unclenched, to avoid injury if the hood lifts suddenly.

95. Abandoning the aircraft

(a) The minimum safe height for ejection in steady level flight is 200 feet at a minimum speed of 120 knots. With seat Mods. 567, 293, 398, 371 and 375, ejections may be made at runway level, but see para. 38(H).

(b) Simultaneous ejection should be avoided, as the observer's seat is angled 1½° towards the pilot's and there is a slight risk of collision.

(c) Proceed as follows:—

	Pilot	Observer.
1.	Lower seat if time permits	Lower seat if time permits.
2.	Stow collimator (if necessary)	
3.	Transmit MAYDAY	Stow A.I. visor fully forward.
4.	JETTISON HOOD	
5.	Holding control column in left hand with right arm across the body clear of the observer's seat, order observer, JUMP, JUMP	Acknowledge. Pull face blind with both hands, ensuring that the arms are kept within the dimensions of the seat.
6.	Immediately the observer has ejected, pull face blind with both hands, ensuring that the arms are kept within the dimensions of the seat	
7.	At 10,000 ft., or if below, automatic separation will take place after 3 seconds and the parachute will develop	At 10,000 ft., or if below, automatic separation will take place after 3 seconds and the parachute will develop.
	IN THE EVENT OF BAROSTAT/TIME CONTROL FAILURE	
8.	Pull the override D-ring	Pull the override D-ring.
9.	Slide hand down port side of seat, push release lever in and pull upwards	Slide hand down port side of seat, push release lever in and pull upwards.
10.	Push away from seat	Push away from seat.
11.	Pull rip-cord D-ring	Pull rip-cord D-ring.

Note 1:—When pulling the face blind, both hands must grasp the firing handle firmly, with the back of the hands facing forward and the elbows close to the body.

NOTE 2 If it is essential to resort to the secondary firing handle, the inboard hand (pilot's right hand, observer's left) must be used, to avoid catching the outboard elbow on the cockpit wall. It is essential to keep the head pressed well back against the parachute pack during ejection.

Note 3:—For details of the sequence of operations of the seat after ejection see AP.129 Flying 6th Edition. The personal survival pack (Dinghy) should be lowered at some convenient altitude during the descent if time allows.

(d) Should the ejection seat fail to fire:—

(i) Pull override D-ring.

(ii) Slide hand down port side of seat, push release lever in and pull upwards.

(iii) Raise flap and grasp rip-cord D-ring.

(iv) Invert aircraft and fall out.

96. Forced landing

Even if the engine is windmilling, it is unlikely that sufficient hydraulic pressure will be generated at 160 knots (the best gliding speed) to maintain the ailerons in power and keep the accumulator charged. The following procedure is therefore recommended:—

(a) Select manual control (see para. 88).

(b) Jettison tip tank fuel and all external stores.

(c) Stow collimator (if necessary)

(d) Transmit distress call.

(e) Jettison the hood if desired (see NOTE 2 below).

(f) Whilst manoeuvring to land maintain a speed of 140 knots until the selected landing area is within reach.

(g) Undercarriage as required.

(h) Lower the flaps, aiming to cross the threshold at 120 knots.

(i) If there is no sign of fire after the landing, return to the aircraft and insert the seat safety pins.

NOTE 1.—Do not use the airbrakes (see para. 89 (b) (i)).

NOTE 2.—It must be remembered that, if the hood is jettisoned, the seat gun is live and care must be taken not to catch a foot in the seat firing handle when leaving the aircraft.

97. Ditching

(a) It is believed that the ditching qualities of this aircraft are poor. It is therefore recommended that the aircraft be abandoned rather than ditched.

(b) If ditching is inevitable:—

(i) Jettison the hood,* tip tanks fuel, and all external stores.
* See para. 96, NOTE 2.

(ii) Remove the leg restraint garters and release the parachute harness and emergency oxygen supply tube.

(iii) Stow collimator (if necessary)

(iv) Transmit distress call.

(v) If engine power is available, make a normal approach using 10° flap.

(vi) The speed at touch down should be the minimum without nose-up attitude, otherwise the tail booms will hit the water first, causing them to break off and the aircraft to dive in.

(vii) Provided the tail booms do not hit first and the sea is calm, the aircraft should plane on its fuselage with the radome clear. To reduce any tendency to porpoise, the rate of descent at touch down should be at a minimum.

97A. Deck landing with wheels up

If, when landing on deck with wheels up, the aircraft fails to catch a wire, the underside of the fuselage may sever the nylon edge ropes at the bottom of the barrier. To avoid a possible break-through, therefore, the pilot should engage the barrier before touching down. Note that the hook should be lowered and, where possible, the flaps.

PART V
OPERATING DATA

98. Loading and C.G. data

NOTE.—1. When making C.G. calculations, reference should always be made to A.P.4360 C Vol. 1, Section 2, Chapter 3.

NOTE.—2. All data below assumes the use of AVTUR fuel (8 lb./gall.)

(a) *Weight and C.G. limitations*

These are given in Part II (Limitations), para. 53.

(b) *Loading data*

(i) *Take-off*

With full internal fuel, wing tip tanks full or empty and irrespective of whether one or two crew members are carried, up to 600 rounds of ammunition and any combination of R.P.'s except Item 7 in para. 98(d) (ii) may be carried at take-off. Ammunition and R.P.'s may be fired at any stage of the flight, without causing the C.G. to move outside the limits.

(ii) *Arrested landing*

Fuel must be reduced to the following values before landing:—

		Fuel remaining			
		Clean aircraft		With R.P. posts & rails	
Crew	Ammunition (rounds)	Lb.	Galls. AVTUR	Lb.	Galls. AVTUR
2	600	1170	146	1132	142
2	—	1545	193	1507	189
1	600	1350	169	1312	164
1	—	1725	216	1687	210

NOTE.—1. Arrested landings should not be made with R.P.'s fitted, except in an emergency.

NOTE.—2. Emergency arrested landings may be made with up to 500 lb. (62 galls.) more fuel than the values quoted above.

(iii) *Airfield landing*

For normal airfield landings, fuel should be reduced to the following values:—

		Fuel remaining			
		Clean Aircraft		R.P.'s fitted	
Crew	Ammunition (rounds)	Lb.	Galls. AVTUR	Lb.	Galls. AVTUR
2	600	1370	172	548	69
2	—	1745	219	923	116
1	600	1550	194	728	91
1	—	1925	241	1103	138

The overload landing weight corresponds to full crew, full internal fuel, full ammo., R.P.s.

NOTE.—Landing must not be made with fuel in the tip-tanks except in emergency.

(c) *Effect of expendable stores*

(i) Consumption of tip-tank fuel causes the C.G. to move forward.

(ii) Consumption of internal fuel causes the C.G. to move aft initially, reaching the aftmost position when approximately 2,288 lb. (286 gallons) remain. The C.G. then moves forward, reaching the most forward position when about 280 lb. (35 gallons) remain.

(iii) Firing ammunition causes the C.G. to move aft.

(iv) Firing 60 lb. head R.P.'s causes negligible C.G. movement.

(v) Firing any other R.P.'s causes the C.G. to move forward.

(d) *Typical service loadings*

(i) With full internal fuel, 600 rounds of ammunition and two crew the all up weight is approximately 14 250 lb.

(ii) With the items in (i), plus full fuel in tip tanks, the weight is 15,450 lb.

(iii) The above weights are increased by the following approximate amounts when R.P. equipment is carried:—

Additional items	Increase in weight, lb.
1. Mk. 8 projector or Mk. 12 launcher	up to 100
2. Mk. 8 projector + 4 × 25 lb. R.P.'s or	200–300
Mk. 12 launcher + 4 × 12 lb. R.P.'s or	
+ 4 × 18 lb. R.P.'s	
3. Mk. 12 launcher + 2 × 52 lb. H.V.A.R. or	300–400
+ 2 × 38 lb. H.V.A.R. or	
+ 4 × 25 lb. R.P.'s	
4. Mk. 8 projector + 4 × 60 lb. R.P.'s or	400–500
Mk. 12 launcher + 8 × 12 lb. R.P.'s	
5. Mk. 8 projector + 8 × 25 lb. R.P.'s or	500–600
Mk. 12 launcher + 8 × 18 lb. R.P.'s or	
+ 8 × 25 lb. R.P.'s	
6. Mk. 12 launcher + 12 × 12 lb. R.P.'s	600–700
7. Mk. 8 projector + 8 × 60 lb. R.P.'s or	800
Mk. 12 launcher + 12 × 18 lb. R.P.'s or	
+ 12 × 25 lb. R.P.'s	

99. **Pressure error corrections**

(a) *Airspeed*

The following are the A.S.I. pressure error corrections (in knots) at sea level.

Airspeed	100	150 to 400	450	500
Correction	−2	−1	−2	−4

(b) *Altimeter*

The following are the altimeter pressure error corrections at sea level.

Airspeed (knots)	150 to 300	350	400	450	500
Correction (feet)	−20	−30	−50	−110	−250

100. **Fuel consumptions**

The following are the approximate fuel consumptions in pounds per minute for various altitudes and power settings. If it is required to know the consumptions in gallons per minute, divide the figures below by the weight of fuel per gallon.

AVTUR = 8.0 lb. per gallon
Normal AVCAT = 8.3 lb. per gallon

Height	at 10,250 r.p.m.	at 9,750 r.p.m.	at best range speed
Sea level	120	90	47
10,000 ft.	90	70	32
20,000 ft.	70	55	25
30,000 ft.	50	40	22
40,000 ft	35	25	21

101. **Take-off distances**

The approximate distances (in yards) to unstick and to clear 50 feet, for various wind and temperature conditions, are given below, for a weight of 16,070 lb.

Temperature °C.		−15	0	+15	+30	+45
Zero wind	Ground run	700	860	1,020	1,180	1,340
	To clear 50 ft.	1,155	1,435	1,715	1,995	2,280
30 knot wind	Ground run	385	515	645	775	900
	To clear 50 ft.	705	925	1,150	1,375	1,595

102. **Flight planning data**

(a) The tables on the following pages show the flight planning data for:—

(i) *Climbing*

The climb table gives the data for climb in I.S.A. conditions, using the speeds recommended in para. 69. Since the climb performance is dependent on temperature, corrections are given for each 10°C rise in temperature above I.S.A.

(ii) *Cruising at best range speed*

Each separate altitude block in the cruise table shows:—

1. The speed for maximum range, the approximate A.N.M. per 100 lb. fuel and the approximate fuel consumption for the particular height. In addition, a speed band is given; use of any speed within this range should not cause more than a 5 per cent. reduction in range.
2. The range obtainable for various amounts of available fuel when flying at the best range speed for that height. The range given is to the point of let-down, allowance being made for the descent fuel required.
3. The range obtainable for various amounts of available fuel, including the distance covered on the climb, if a climb is made to another altitude. In this case the climb must be made at the speed given in para 69 and the flight continued at the new altitude at the best speed for that height.

NOTE.—The range at any altitude is independent of temperature but dependent on the weight of fuel carried.

(iii) *Descent*

The descent table gives the data for descending from one height to another.

(b) *Use of the tables*

(i) *Pre-flight planning*

Enter the cruise data table in the sea level block at the fuel state applying immediately after take-off. Select the height at which maximum range is available at that fuel state. The distance available includes distance covered on the climb but not on descent. (Absolute maximum range is obtained by adding on the descent distance, provided that the let-down commences at that distance from the destination.) For short range flights inspect the sea level block and select the height at which the distance to be covered requires the least amount of fuel. This is the best altitude for the flight.

(ii) *In-flight planning*

At any stage of the flight the available range may be ascertained by applying the fuel state to the level flight range in the particular altitude block. If an increase in range is required or if a climb has to be made, the new available range may be obtained by entering the existing altitude block at the particular fuel state and moving vertically downwards within the block until the new altitude is reached. Figures in heavy type indicate the best altitude for the maximum increase in range. Above these heights no further range increase is possible. If a descent is necessitated, the new range is shown by moving direct from the existing altitude level flight range for the particular fuel state to the new altitude level flight range.

(c) *Cruise data chart*

The cruise data chart shows aircraft performance and fuel consumption in level flight at various heights and r.p.m.

103. **Use of R.A.T.O.G. Chart**

Reserved

104. **Endurance**

At any altitude, maximum endurance will be obtained by flying at the I.A.S. which requires the lowest r.p.m. to maintain height. This speed is about 185 knots. Increase in altitude gives increase in endurance; however, the overall endurance may not be improved by climbing above 15,000 feet, except when maximum fuel is available,

owing to the proportion of fuel used on the climb and the descent. All climbs should be made at full power (within the jet pipe limitations) and the descent made as quickly as practicable.

105. **A.Y.F. errors**

Reserved

CLIMB DATA

Climb at 10,250 r.p.m. below 25,000 ft.
10,100 r.p.m. above 25,000 ft.

From	To	Lb.	Dist. (n.m.)	Mins.
Sea Level	10,000′	210	12	2.5
	20,000′	420	28	5.75
	30,000′	650	53	10.5
	40,000′	945	103	19.5
10,000′	20,000′	210	16	3.25
	30,000′	430	41	8.0
	40,000′	735	91	17.0
20,000′	30,000′	230	25	4.75
	40,000′	525	75	13.75
30,000′	40,000′	295	50	9

For each 10°C rise in temperature above I.S.A. conditions add:—

From	To	Lb.	Dist.	Mins.
Sea Level	10,000′	18%	17%	15%
10,000′	20,000′	19%	19%	15%
20,000′	30,000′	20%	21%	17.5%
30,000′	40,000′	21%	23%	20%

FUEL CONTENTS:— 462 GALLONS
3696 lb. AVTUR (8 lb./gall.)
3830 lb. NORMAL AVCAT (8.3 lb./gall.)
TAXY AND TAKE-OFF ALLOWANCE .. .. 370 lb.
LANDING ALLOWANCE (excluding descent fuel) 700 lb.

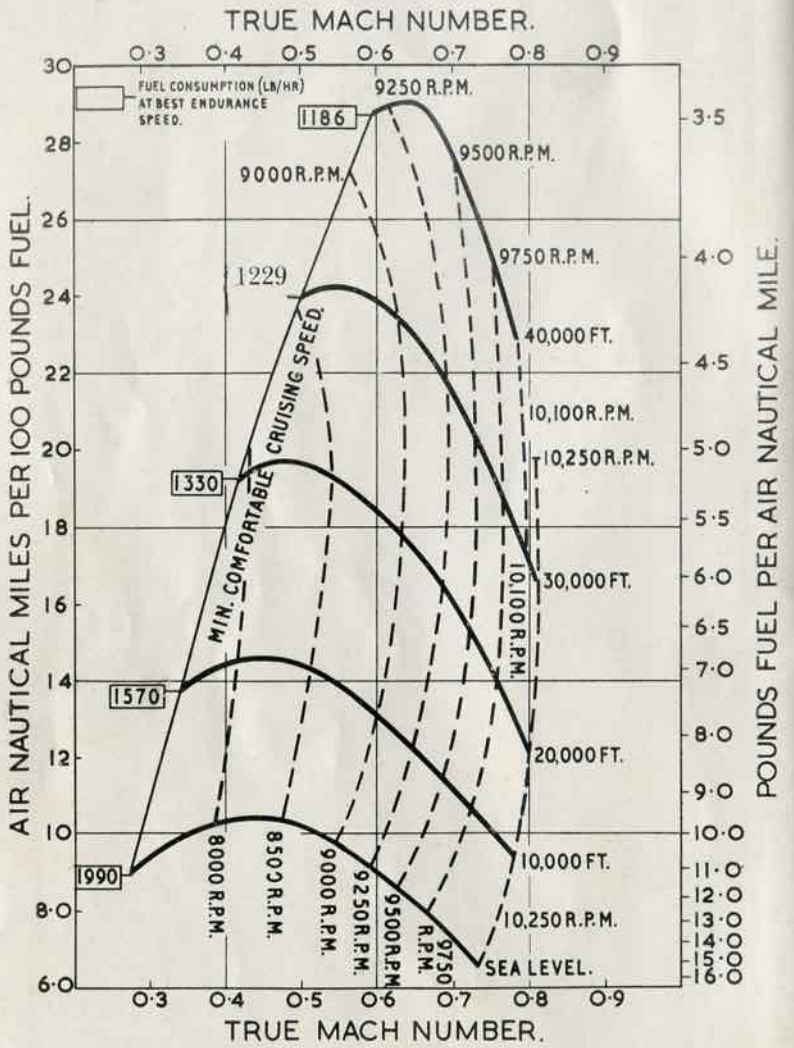
DESCENT DATA

AIRBRAKES - OUT
R.P.M. - 6,500
SPEED - 0.67M above 25,000′
270 kts. below 25,000′

From	To	Lb.	Dist.	Mins.
40,000′	30,000′	10	9	1.5
	20,000′	20	15	2.5
	10,000′	30	24	4.0
	Sea Level	40	35	6.0
30,000′	20,000′	10	6	1.0
	10,000′	20	15	2.5
	Sea Level	30	26	4.5
20,000′	10,000′	10	9	1.5
	Sea Level	20	20	3.5
10,000′	Sea Level	10	11	2.0

CRUISE DATA — NO EXTERNAL STORES

FUEL AVAILABLE	POUNDS	3400	3000	2500	2000	1500	1000
	GALL (AVTUR)	425	375	313	250	188	125
Sea Level	Range	284	242	189	137	84	**32**
ANM/100 lb. —10.5	10,000′	374	316	243	170	97	24
Lb./hr. —2,830	20,000′	474	395	296	198	**99**	—
Best Range IAS— 298 kts (0.45M)	30,000′	544	447	325	**204**	82	—
95% Range IAS— 0.34M-0.53M	40,000′	**602**	**486**	**340**	195	—	—
10,000 ft.	Range	—	335	262	189	116	**43**
ANM/100 lb. —14.6	20,000′	—	425	326	227	**126**	30
Lb./hr. —1,925	30,000′	—	488	367	245	124	—
Best Range IAS— 244 kts (0.44M)	40,000′	—	**538**	**393**	**248**	102	—
95% Range IAS— 0.34M-0.56M							
20,000 ft.	Range	—	450	351	253	154	**55**
ANM/100 lb. —19.75	30,000′	—	523	402	280	**159**	37
Lb./hr. —1,495	40,000′	—	**583**	**438**	**293**	147	—
Best Range IAS—219 kts (0.48M)							
95% Range IAS—0.42M-0.58M							
30,000 ft.	Range	—	—	430	309	**187**	**66**
ANM/100 lb. —24.3	40,000′	—	—	**477**	**331**	185	40
Lb./hr. —1,310							
Best Range IAS—201 kts. (0.54M)							
95% Range IAS—0.5M-0.65 M							
40,000 ft.	Range	—	—	512	367	222	76
ANM/100 lb. —29.1							
Lb./hr. —1,260							
Best Range IAS—191 kts (0.64M)							
95% Range IAS—0.6M-0.7M							
FUEL AVAILABLE	POUNDS	3400	3000	2500	2000	1500	1000
	GALLS (AVCAT)	411	362	302	242	181	121



CRUISE DATA CHART—NO EXTERNAL STORES

Appendix A Attack Data

The following table gives the attack data when using R.P.s. In all cases the gyro sight is to be set to GYRO DAY and the wing span to R.P. (73 ft.). Using a caged gyro, the sight must not be uncaged during the dive by pressing the camera button.

	Direct Hits						Underwater Hits—25 lb. R.P.s		
	60 lb. head R.P.s			25 lb. head R.P.s			*Target* Snorting submarine *Point of aim* the Snort *R.P. Type* A/S No. 1 Mk. 1 Type D	*Target* Destroyer or freighter *Point of aim* Water line *R.P. Type* A/S No. 1 Mk. 1 Type D	*Target* Destroyer or freighter *Point of aim* Water line *R.P. Type* A.P. Shot No. 1 Mk. 1
Dive angle	15°	30°	45°	15°	30°	45°	15°	15°	20°
True release height (ft.) ..	1,000	2,000	2,500	1,000	2,000	2,500	1,000	1,000	1,000
Release speed (knots, I.A.S.)	400	420	420	400	420	420	400	400	400
Uncaged gyro									
Range drum (yds.) ..	230	270 (M.R.P.)	360 (S.R.P.)	300	340	460	370	300	350
Aiming point	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond
Fixed ring Aiming point	1½ rads (2° 57′)	1¼ rads (2° 34′)	Just under 1 rad (1° 50′)	Just over 1 rad (2° 17′)	1 rad (1° 56′)	¾ rad (1° 22′)	Just under 1 rad (1° 46′)	Just over 1 rad (2° 17′)	Just under 1 rad (1° 52′)
Caged gyro									
Range drum (yards) ..	320	370	580	430	540	630	610	430	560
Aiming point	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond	Top of 6 o'clock diamond	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond	Bottom of 6 o'clock diamond
Remarks							The rocket will fall 39 yds. short of the snort		The rocket will fall 6 yds. short of the water line

PART VI

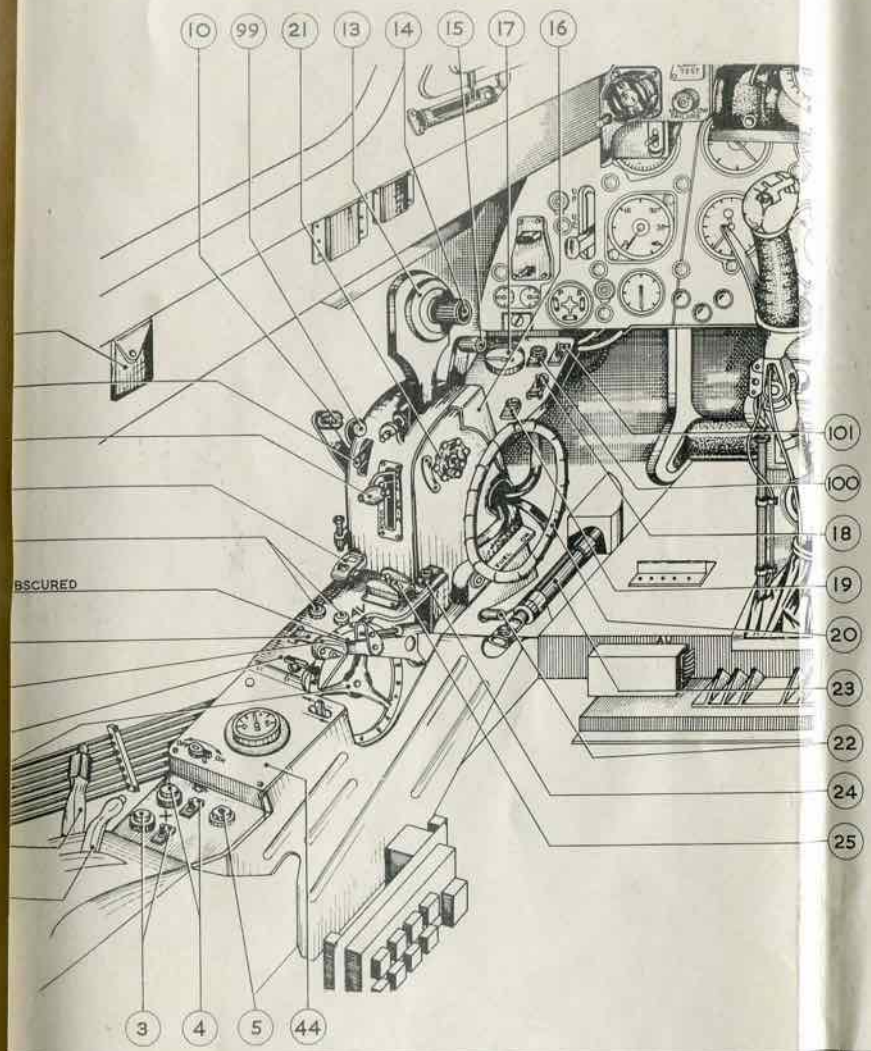
ILLUSTRATIONS

KEY TO FIGS. 1, 2 AND 3

1. Wing spread/fold lever
2. Wing locking lever
3. Port flood lamps dimmer and switch
4. Panel lamps dimmer and switch
5. Instrument panel lamps dimmer
6. RATOG jettison pushbutton
7. Aileron trim cut-out switch
8. Port and starboard wing lock warning indicators
9. Tip tank fuel jettison switch
10. H.P. cock lever and relight button
11. Flaps selector lever
12. Elevator trim position indicator
13. Throttle lever
14. Press-to-transmit button
15. Airbrakes control
16. RATOG firing switch
17. Triple pressure gauge
18. Undercarriage emergency retraction switch
19. Aileron trim warning light
20. Elevator trim control
21. Throttle friction damper
22. L.P. cock lever
23. Aileron spring-feel strut adjuster
24. Arrester hook indicator light
25. Aileron manual trim switch
26. Arrestor hook control lever
27. Cockpit temperature and pressure control
28. Windscreen de-icing pump
29. Aileron variable gear control
30. Windscreen wiper control
31. Radio altimeter (AYF)
32. Undercarriage position indicator
33. Flaps position indicator
34. Undercarriage selector lever
35. Green Salad indicator
36. E2A Compass
37. Generator failure warning lights
38. Main inverter failure indicator
39. GGS collimator mounting-bracket
40. Fuel transfer indicators
41. Fuel pressure indicator
42. Accelerometer
43. Observer's oxygen flow indicator

44. Pilot's oxygen regulator
45. RATOG warning light
46. RATOG master and safety switches
47. Hydraulic flow failure warning light
48. Starter pushbutton
49. GGS dimmer-selector control
50. Oxygen contents gauge
51. Starter master switch
52. Flight instruments master switch
53. Booster pump switch
54. Pressure head heater switch
55. Hatch strut release lever
56. Fire-extinguisher pushbutton and warning light and light test pushbutton
57. Fuel contents gauge
58. Inoperative
59. Emergency lamps switch
60. Green Salad indicator-lamp switch
61. Observer's mute switch
62. GGS master selector switch and pairs/salvo selector
63. VHF controller
64. Hood jettison handle
65. Aileron power selector
66. Hydraulic hand pump
67. Cockpit pressure warning light
68. Cockpit altimeter
69. Turn and slip emergency supply switch
70. Oil temperature gauge
71. IFF master switch
72. Four circuit breakers, reading from left to right: Fuel pump, External lights, Instrument inverters (standby and main)
73. Generator failure warning lights
74. GGS collimator (stowed position)
75. Radar inverter switch
76. Radar inverter d.c. supply indicator
77. Battery master switch
78. Aileron trim circuit breaker
79. RT/Mix/Beacon switch
80. Carrier/airfield switch
81. Identification lights morse/steady switch
82. ZBX controller
83. Fuel pump test switch and socket
84. Intercomm. on/off switch
85. Intercomm. normal/emergency switch
86. Observer's RT/beacon switch
87. IFF Aerial switch
88. Observer's oxygen regulator
89. Mk. 4F compass controller
90. IFF controller
91. Observer's press-to-transmit switch
92. Starboard console lights dimmer
93. Gunsight circuit breaker
94. Landing lamp switch
95. G.45 Camera master and sunny/cloudy switches
96. Navigation lights off/morse switch
97. Navigation lights dim/morse/bright switch
98. Main instrument inverter ground test and reset switches

99. H.P. cock lever locking catch
100. Aileron power warning indicator
101. Radar dousing switch
102. GGS master switch
103. Artificial horizon and fast erection button
104. GGS
105. GGS collimator control unit
106. Outside air temperature gauge
107. Pilot's oxygen flow indicator
108. Main fuel tank contents check switch
109. Radar control panel
110. Inspection lamp socket
111. Air conditioning diffuser nozzle
112. Canopy gun locking pin stowage
113. Jet pipe thermometer
114. Rate of climb indicator
115. Mk. 4F compass indicator
116. Air speed indicator
117. Machmeter
118. Altimeter
119. Green Salad control unit
120. Turn and slip indicator
121. R.P.M. indicator



BSCURED

FIG. 1 COCKPIT — PORT SIDE

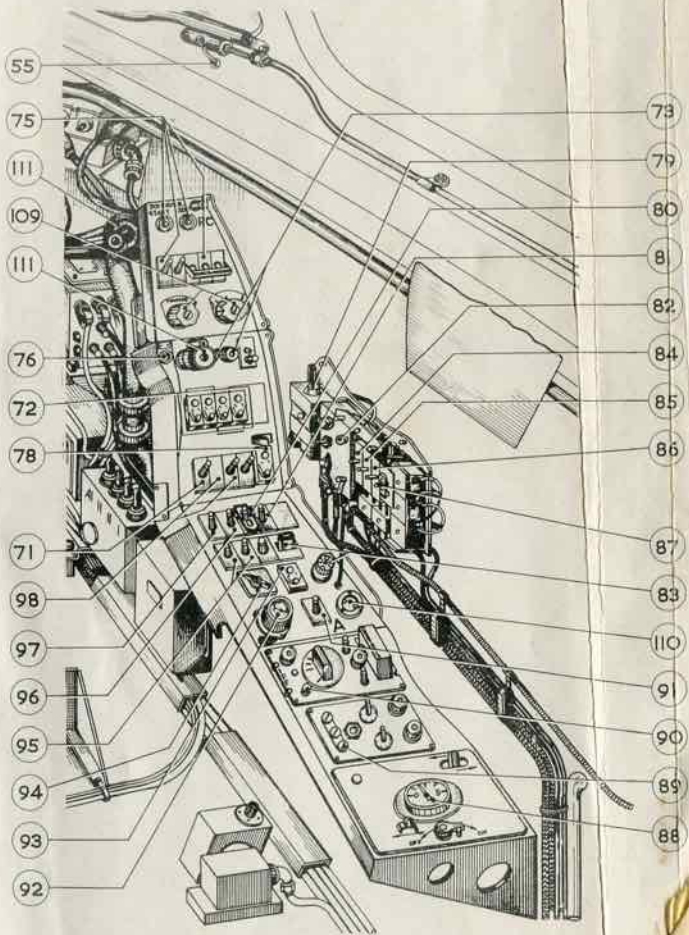


FIG. 3 COCKPIT — STARBOARD SIDE

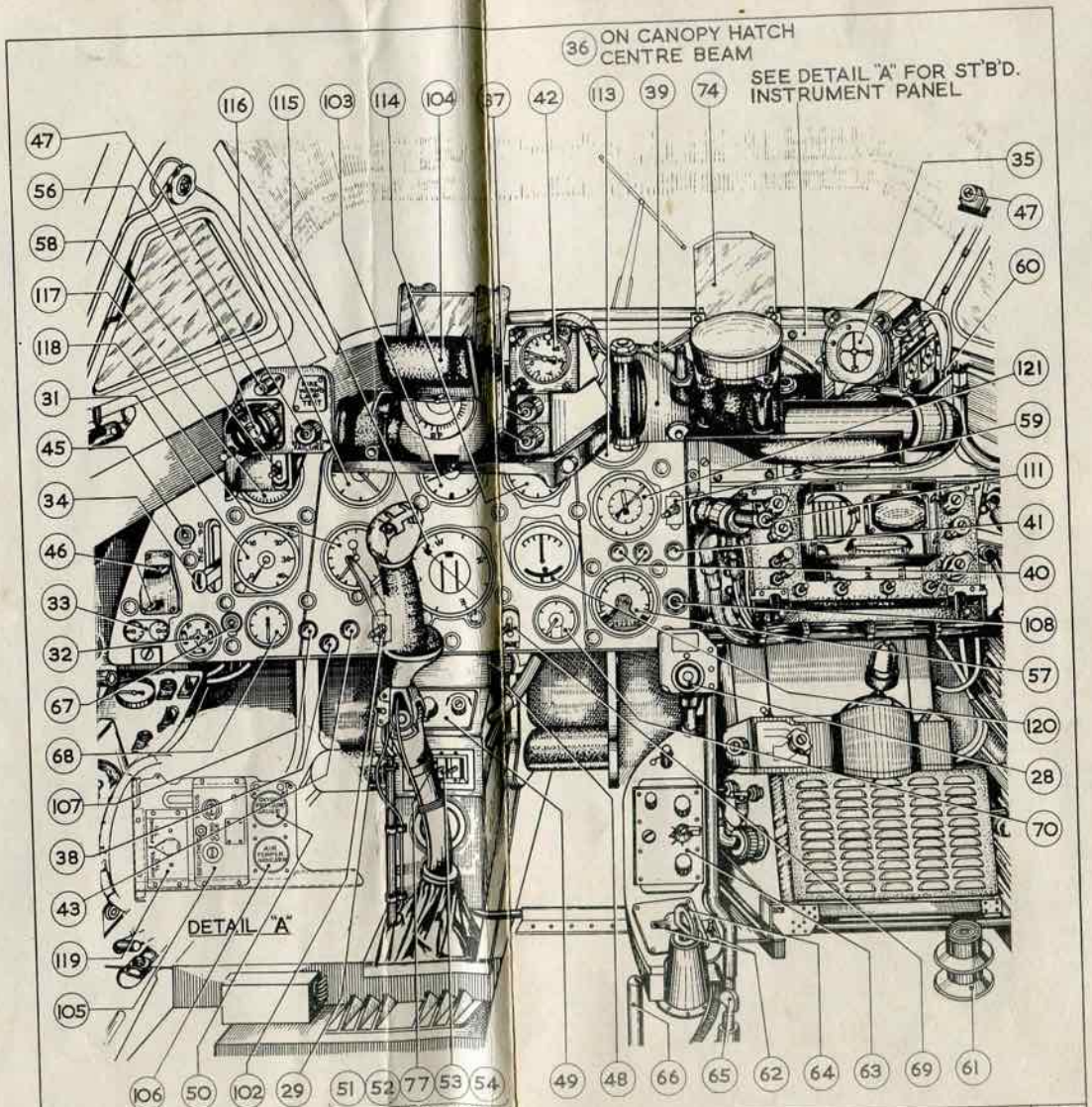


FIG. 2 COCKPIT — FORWARD VIEW FIG. 2