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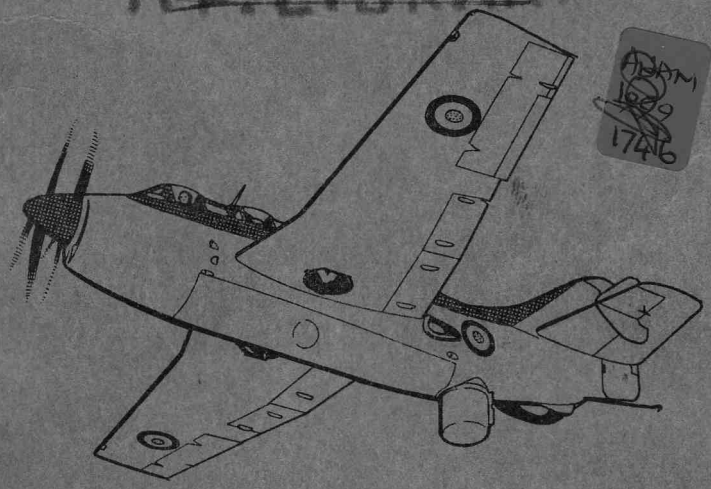
A.P. 4487A—P.N.
Pilot's Notes

PILOT'S NOTES

GANNET A.S.1



Prepared by Direction
of the
Minister of Supply

R. Musgrave

Promulgated by Command
of
Their Lordships

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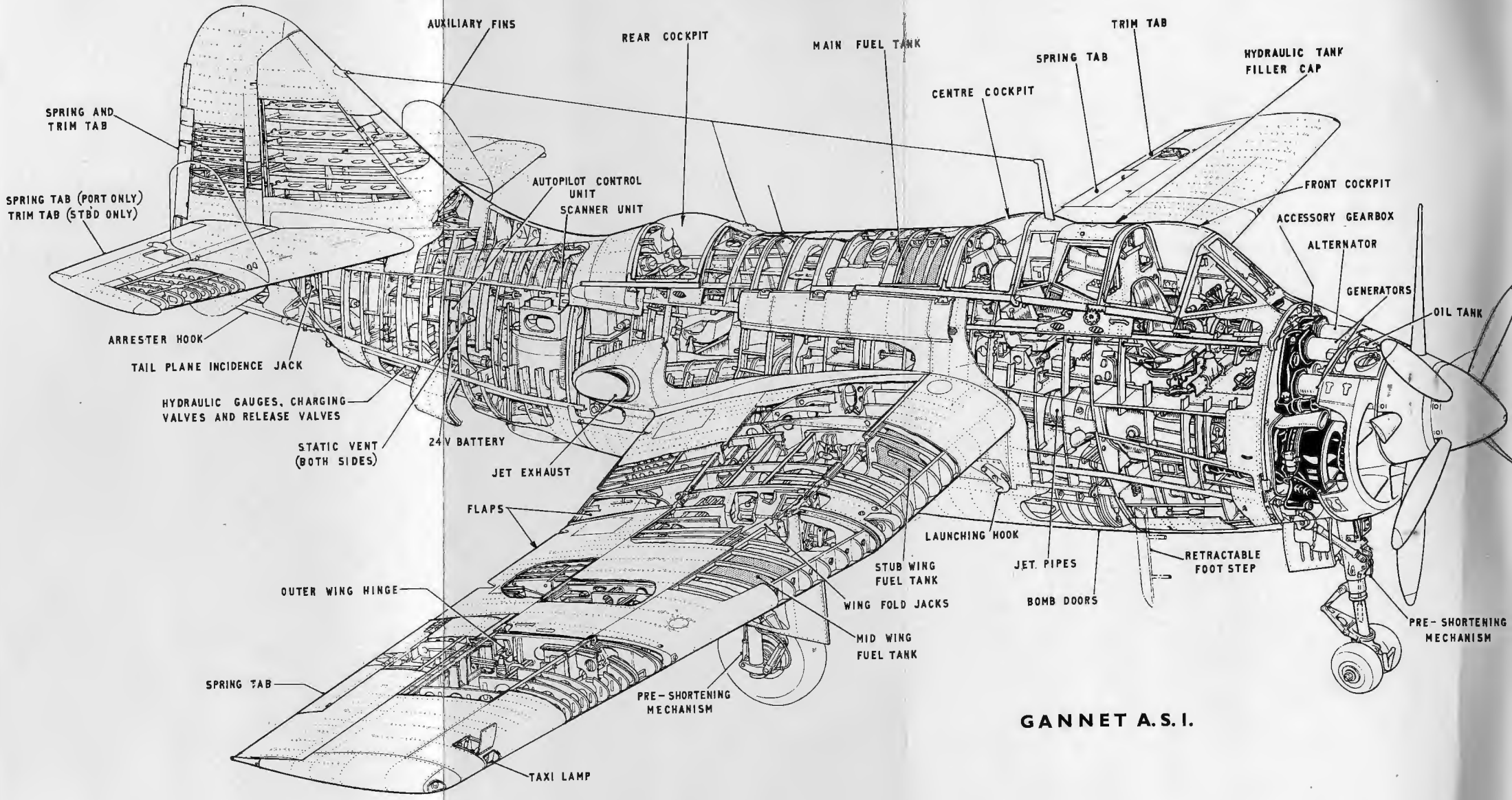

AUXILIARY FINS
REAR COCKPIT
MAIN FUEL TANK
TRIM TAB
SPRING TAB
HYDRAULIC TANK FILLER CAP
CENTRE COCKPIT
SPRING AND TRIM TAB
AUTOPILOT CONTROL UNIT
SCANNER UNIT
FRONT COCKPIT
ACCESSORY GEARBOX
ALTERNATOR
GENERATORS
OIL TANK
SPRING TAB (PORT ONLY)
TRIM TAB (STBD ONLY)
ARRESTER HOOK
TAIL PLANE INCIDENCE JACK
HYDRAULIC GAUGES, CHARGING VALVES AND RELEASE VALVES
STATIC VENT (BOTH SIDES)
24V BATTERY
JET EXHAUST
FLAPS
LAUNCHING HOOK
RETRACTABLE FOOT STEP
STUB WING FUEL TANK
JET PIPES
OUTER WING HINGE
WING FOLD JACKS
BOMB DOORS
PRE-SHORTENING MECHANISM
MID WING FUEL TANK
SPRING TAB
PRE-SHORTENING MECHANISM
TAXI LAMP

GANNET A.S.I.

2108

NOTES TO USERS

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

Additional copies may be obtained from Head of Military Branch (Books), Admiralty Block C, Station Approach Buildings, Kidbrooke, by application on Royal Navy Forms S.134D or D.397. The number of the publication must be quoted in full—A.P.4487A—P.N.

Comments and suggestions should be forwarded through the usual channels to the Admiralty (D.A.W.).

AMENDMENTS

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

Each amendment list will, where applicable, be accompanied by gummed slips for sticking in the appropriate places in the text.

Incorporation of an amendment list must be certified by inserting date of incorporation and initials below.

A.L. NO.	INITIALS	DATE	A.L. NO.	INITIALS	DATE
1			4		
2			5		
3			6		

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 shaft horsepowers quoted are "Indicated".

Introduction

(a) The Gannet A.S.1 is a mid-wing monoplane designed for anti-submarine duties with the Royal Navy. It is powered by a Double-Mamba 100 gas turbine engine driving contra-rotating, co-axial, four-bladed propellers. The crew consists of a pilot in the front cockpit, an observer in the middle cockpit and a crewman in the rear cockpit. Power-folding wings and an arrester hook are fitted, and provision is made for catapult launching. Bombs and other stores may be carried in the bomb bay and under the wings.

(b) The Double-Mamba is basically two side-by-side propeller turbine engines, each driving one propeller through independent gear trains. The port engine drives the front propeller. Each engine is a separate unit having its own controls and fuel and oil systems, so that each one may be operated independently of the other. A common auxiliary gear box is driven by either or both engines.

(c) The principal dimensions of the aircraft are:—

Height to top of fin	13 ft. 9 in.
Height required for folding wings	16 ft. 9 in.
Height to top of folded wings ..	13 ft. 9.7 in.
Length overall (including hook) ..	44 ft. 6 in.
Span	54 ft. 4 in.
Maximum width, wings folded ..	19 ft. 11 in.
Span of tailplane	19 ft. 6 in.

FUEL AND OIL SYSTEMS

1. **Fuel system description**

(a) Fuel is carried in five tanks; a main tank in the fuselage between the centre and rear cockpits, two stub-wing tanks and two mid-wing tanks. Provision is also made for fitting a pair of jettisonable long-range tanks in the bomb bay. The bomb bay tanks are jettisoned by the bomb jettisoning controls (see para. 69).

(b) Fuel is fed to the engines from the main tank by a single booster pump, through two L.P. cocks, one for each engine. Fuel from all other tanks is transferred automatically to the main tank by air pressure from the compressor stages of either or both engines. The order of transfer is as follows:—

(i) From the bomb bay tanks (if fitted), when the level in the main tank has dropped to about 950 lb.

(ii) From the mid-wing tanks when the bomb bay tanks are empty and the level in the main tank has dropped to about 900 lb.

(iii) From the stub-wing tanks when the mid-wing tanks are empty and the level in the main tank has dropped to about 850 lb.

The correct order of transfer is ensured, and flooding of the main tank prevented, by three float valves in the main tank.

(c) Fuel is delivered to the engine combustion chambers through main burners and starting jets. The starting jets only operate during the starting (or relighting) cycle (see para. 18).

2. **Fuel tanks**

(a) The main tank is of the flexible bag type and is in the fuselage between the centre and rear cockpits. The filler cap is in the top of the fuselage immediately aft of the centre cockpit.

(b) The stub- and mid-wing tanks are also of the flexible bag type. The stub-wing tanks are in the leading edge of the inner, fixed part of the wing, and are each provided with a filler cap near the wing root. The mid-wing tanks are in the leading edge of the centre part of

each wing. Two filler caps are provided for each mid-wing tank, one for use when the wings are spread and the other to enable the tanks to be filled when the wings are folded.

(c) The effective tank capacities are as follows:—

	Gallons	lb. at 0.8 S.G.
Main tank	129	1,032
Stub-wing tanks (2 × 102 gall.)	204	1,632
Mid-wing tanks (2 × 65 gall.)	130	1,040
Total normal fuel	463	3,704
Bomb bay tanks (2 × 81 gall.)	162	1,296
Total long range fuel	625	5,000

3. **L.P. fuel cocks**

Two low pressure fuel cocks, one in the supply line from the single booster pump to each engine, are operated by levers (4 and 5) on the cockpit port side aft of the pilot's seat. The fuel cock levers also control the fuel booster pump and the inverters for the flying instruments and automatic J.P.T. control (see para. 15), these being switched on when either L.P. cock is turned ON, and switched off when both L.P. cocks are turned OFF.

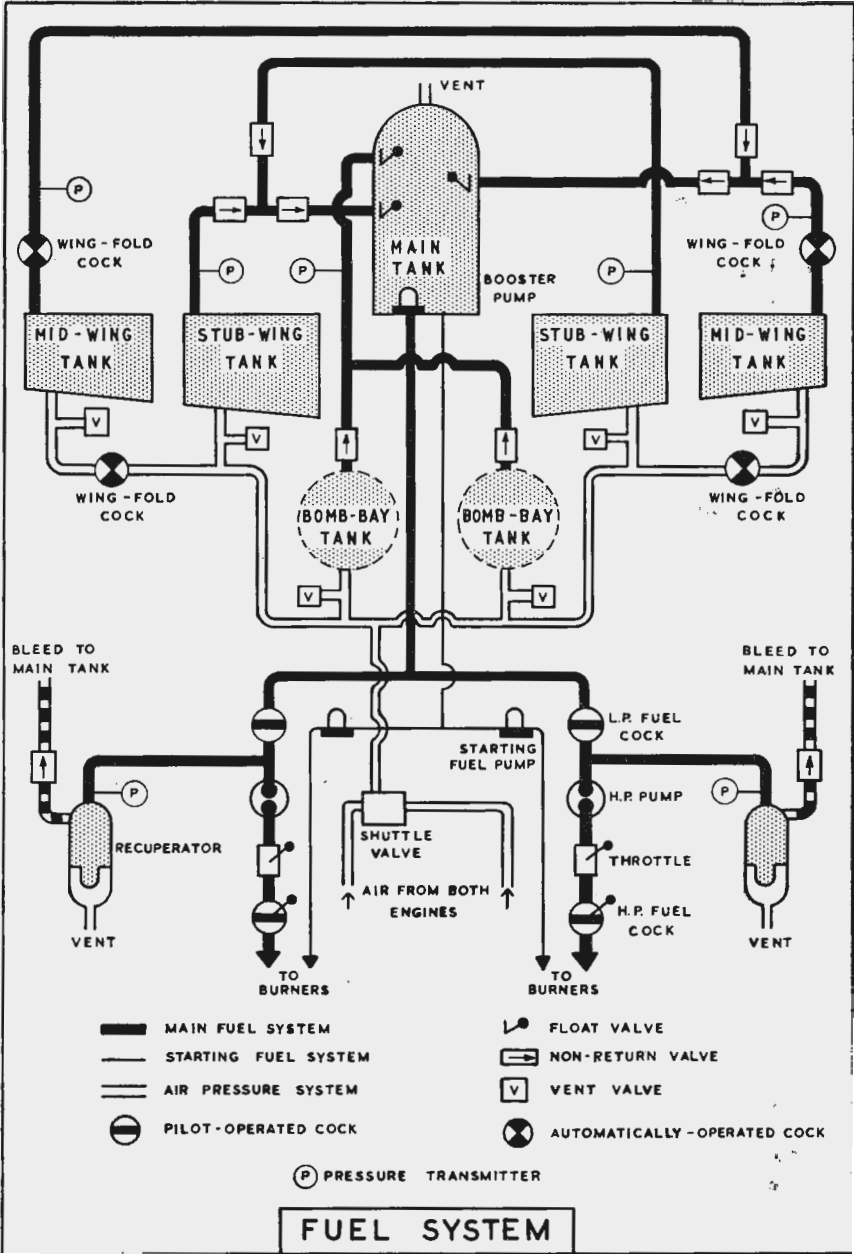
4. **H.P. fuel cocks**

The two high pressure fuel cocks are controlled by levers (31 and 35) on the cockpit port side, aft of the throttle levers. Each lever incorporates a relight button which, with the lever, is used to control the ignition, feathering pump, starting fuel pump and propeller brake (see para. 11).

5. **Fuel booster pump and recuperators**

(a) The single fuel booster pump in the main tank is operated by the L.P. fuel cock levers (4 and 5). When either L.P. fuel cock is opened the booster pump starts running, and stops when both L.P. cocks are shut.

(b) Mod. 204 introduces two fuel recuperators, one for each engine, and two magnetic warning indicators (16) on the cockpit port side. The recuperators ensure a supply of fuel to the suction side of the engine-driven fuel pumps during catapult launches. They do not provide for


VENT
MAIN TANK
BOOSTER PUMP
WING - FOLD COCK
WING - FOLD COCK
MID - WING TANK
STUB - WING TANK
STUB - WING TANK
MID - WING TANK
WING - FOLD COCK
WING - FOLD COCK
BOMB - BAY TANK
BOMB - BAY TANK
BLEED TO MAIN TANK
BLEED TO MAIN TANK
L.P. FUEL COCK
STARTING FUEL PUMP
H.P. PUMP
RECUPERATOR
SHUTTLE VALVE
THROTTLE
AIR FROM BOTH ENGINES
H.P. FUEL COCK
VENT
VENT
TO BURNERS
TO BURNERS
MAIN FUEL SYSTEM
STARTING FUEL SYSTEM
AIR PRESSURE SYSTEM
PILOT - OPERATED COCK
FLOAT VALVE
NON - RETURN VALVE
VENT VALVE
AUTOMATICALLY - OPERATED COCK
PRESSURE TRANSMITTER

FUEL SYSTEM

conditions of negative G during flight. The warning indicators show black when the booster pump is running and there is an adequate fuel pressure in the recuperators. They show white if the booster pump fails.

6. **Starting fuel pumps**

Two electrical pumps, one for each engine, provide high pressure fuel for starting or relighting in the air. A double-pole master switch (93) is on the cockpit starboard wall; when this switch is ON the appropriate fuel pump will run only when the starting or relighting cycle is energised, i.e. when the relight button or starter button is pressed with the H.P. cock ON, and the throttle at GROUND IDLE (see para. 11).

7. **Fuel contents gauge**

The fuel contents gauge (85) is on the port side of the instrument panel. The gauge normally shows, on the inner scale, the contents, in pounds, of the main tank only, but will show, on the outer scale, the total contents of all tanks when the pushbutton (84) on the lower instrument panel is pressed. No provision is made for showing the contents of the bomb bay tanks (when fitted). If Mod. 55 is not fitted, the gauge reads in gallons instead of pounds; it is calibrated for AVTUR.

8. **Fuel transfer indicators**

Four magnetic indicators (76), on the right of the lower instrument panel show black when air pressure is sufficient to transfer fuel from the wing tanks, and white when the respective tank is empty or if there is insufficient air pressure to transfer fuel. A fifth indicator (74) on the starboard front panel gives similar indication for the bomb bay tanks; it stays white when the bomb bay tanks are not fitted. They should show black within one minute of starting an engine, but the mid-wing tank indicators will not show when the wings are folded. The main tank contents should not drop below 800 lb. until all wing tanks (and bomb bay tanks, if fitted) are empty (see para. 73 (b)).

9. **Oil system**

(a) An oil tank with two separate compartments, one for each engine, is mounted on the forward end of the

power plant. It has a total capacity of 6½ gallons including a reserve of oil for feathering the propellers. Oil pressure (78 and 81) and temperature (80) gauges are on the lower instrument panel. The oil coolers are mounted between the compressor units, immediately aft of the air intakes.

(b) The two-position oil cooler shutters are electrically controlled by two switches (17), marked OPEN and CLOSED, on the cockpit port wall. Different types of actuators may be fitted. If Rotax actuators are fitted the shutters open automatically in the event of electrical failure; if Weston actuators are fitted the shutters fail in the selected position. If single-engine flying is to be undertaken, the shutters for the engine to be stopped should be closed just before shutting down, and left closed until the engine is re-lit.

ENGINE CONTROLS

10. **Throttle controls**

(a) The throttle levers (12 and 13) are in a gated quadrant on the cockpit port side. The GROUND IDLE setting is fully aft, the FLIGHT IDLE setting is at the gate, and the OPEN setting is fully forward. The friction damping is not adjustable.

(b) A propeller control unit maintains each engine at a constant r.p.m., change in power being absorbed by changing the propeller pitch. With the throttle fully open, and at all other settings down to the FLIGHT IDLE gate, the r.p.m. are normally 15,000±100. On the ground, when the throttles are less than about a third open the r.p.m. drop below 15,000 to between 14,200 and 14,400 at the FLIGHT IDLE gate, and to 9,200 to 9,600 when the throttles are at GROUND IDLE. These r.p.m. will be lower if one engine only is operating, and vary with wind speed and oil temperature.

(c) An anticipator is fitted which momentarily over- or under-selects r.p.m. as the throttle is moved, thus ensuring a quick thrust response when changing power.

(d) A delay mechanism is incorporated, so that even if the throttle is opened very quickly from FLIGHT IDLE to fully open, full power will only come on progressively, in about 3 to 4 seconds. This does not operate below the FLIGHT IDLE gate.

(e) A throttle locking control, interconnected with the flying controls locking lever, limits the throttle opening when the flying controls are locked.

11. **H.P. cocks and relight buttons**

(a) The H.P. cocks are controlled by levers (31 and 35) in a quadrant aft of the throttle levers. They have three positions, ON (fully up), OFF (central) and FEATHER AND BRAKE (fully down). Each lever incorporates a button hereafter referred to as a relight button, which, depending on the position of the lever controls the ignition, starting fuel pump, feathering pump, and propeller brake. An interlock prevents the H.P. cock being shut when the throttle is more than one third open.

(b) The function of the relight button is inter-related with that of the H.P. cock lever in the following way:—

(i) *H.P. cock ON.* H.P. fuel cock open and propeller brake released. Pressing the relight button operates the feathering pump to fine off the propeller and starts a time switch which gives 7 seconds operation of the ignition and starting fuel pump, and also causes the starting jets to operate for 7 seconds.

NOTE.—At any time the time switch can only be started when the throttle is hard up against the GROUND IDLE gate and the H.P. cock is ON. The time switch will stop if the H.P. cock is put OFF, or when the throttle is moved from GROUND IDLE.

(ii) *H.P. cock OFF.* H.P. fuel cock shut. Pressing the relight button only operates the feathering pump to fine off the propeller. Releasing the relight button stops the feathering pump.

(iii) *H.P. cock FEATHER AND BRAKE.* H.P. fuel cock shut. The propeller control unit is selected to coarsen the pitch, using engine oil pressure if the engine is turning. Pressing the relight button operates the feathering pump to feather the propeller. As soon as the propeller is fully feathered, provided the button is kept pressed, the propeller brake is applied. The ignition and the starting fuel pump do not operate. Releasing the relight button stops the feathering pump, the propeller brake being left on.

12. **Reverse torque switch**

(a) Under conditions such as engine failure, when the propeller drives the turbine, an electrically-operated reverse torque switch in each engine automatically causes the propeller pitch to be coarsened until positive torque is restored. While reverse torque exists the appropriate one of two magnetic indicators (77) on the instrument panel will show white. To complete the feathering operation and stop the propeller, the H.P. cock lever should be set to FEATHER AND BRAKE and the relight button pressed.

NOTE.—On early aircraft the reverse torque indicators are warning lights which come on when reverse torque exists.

(b) The reverse torque switch is inoperative when the throttle is below the FLIGHT IDLE setting and the H.P. cock lever is ON. Thus it does not operate during the initial stage of windmill starting.

13. **Propeller brakes**

(a) The propeller brakes are operated by feathering pump oil and are kept on by pressure in an accumulator which should hold the brakes on for a minimum of two hours. They are primarily intended to help the ground run-down and to prevent the propellers windmilling on the deck. They are controlled by the H.P. cock levers and relight buttons (see para. 11), each brake being released by the action of moving the appropriate H.P. cock lever from OFF to ON.

(b) In the air, the blade angle when fully feathered is such that the air stream tends to turn the propeller in the reverse direction. A ratchet in the engine reduction gear prevents this and holds the propeller stationary, even if the brake is not applied.

14. **Propeller fine pitch stops**

(a) Two fine pitch stops are provided for each propeller, one fixed at 6° pitch and the other, a removable flight fine pitch stop, set at 21° pitch.

(b) The flight fine pitch stop is a safety device to prevent the blades fining off in flight to an angle of dangerously high drag in the event of P.C.U. failure. It is automatically withdrawn when the undercarriage down button is in, thus allowing the propeller to constant speed on the approach and to take up the fully fine position for starting and ground idling. It is set to re-engage when the undercarriage is selected up.

(c) Two guarded switches (24), marked NORMAL and ENGAGED, are on the port console panel. Under all ordinary conditions of flight these switches should be set at NORMAL, but in the event of suspected or actual P.C.U. failure the appropriate switch should be set to ENGAGE *before* lowering the undercarriage. This overrides the automatic withdrawal of the F.F.P. stop. The H.P. cock should be closed as soon as possible after touchdown to avoid excessive jet pipe temperatures.

(d) In the event of electrical failure the F.F.P. stops will remain engaged, and the engines must therefore be stopped as soon as possible after touchdown to avoid excessive jet pipe temperatures.

15. **Automatic j.p.t. control units**

(a) An automatic jet pipe temperature control unit in each engine limits the j.p.t. to a maximum of 580° C. $\pm$5° C. If the j.p.t. reaches this figure, an electrically-operated spill valve reduces the fuel flow to the engine, thus preventing the j.p.t. from increasing further. The maximum reduction in flow is 20 per cent of the take-off flow, i.e. up to 240 S.H.P. per engine. It should be noted that the control is at 5° C. below the actual

limitation. The j.p.t. at max. continuous must be controlled by the throttle. For starting, since the controller will attempt to control at 580° C., it will normally be necessary to switch to WARNING ONLY (see sub-para. (c)). The warning bell will then operate at about 680° C. In low ambient temperatures the controller may not operate at all, as j.p.t. may be appreciably below the control datum.

(b) If the j.p.t. exceeds the datum by about 100° C., a warning bell sounds in the cockpit and the appropriate red light (62) below the j.p.t. gauge comes on. This is an indication to check the j.p.t. and not necessarily a directive to stop the engine. The warnings will continue until the j.p.t. has returned to its datum.

(c) The j.p.t. control units are controlled by two switches (25) marked NORMAL (forward) and WARNING ONLY, beside the throttle quadrant. The switches should usually be set to NORMAL, when the control units will be in operation. If the units fail in flight, leading to maximum fuel spill, the switches should be set to WARNING ONLY. The fuel spill will then not take place, but the warning bell and lights will still function. The j.p.t. must then be kept within the limits by throttle adjustment.

16. **Ignition system**

The igniters are energised either by the relight buttons and time switch, or by the starter buttons. In both cases the H.P. cock must be ON and the throttle fully closed to GROUND IDLE. Ignition warning lights (22), which come on when the igniter circuits are energised, are on the panel beside the throttle quadrant. The ignition cycle lasts for 7 seconds, at the end of which time the igniters (and starting fuel pump) are automatically switched off.

17. **Engine synchroniser**

An engine synchroniser, fitted to the starboard engine, is controlled by a spring-loaded switch (27) on the port console panel. To synchronise the engines, the switch should be held in the direction opposite to the rotation of the propeller "shadow", i.e. to port to decrease the r.p.m. of the starboard engine.

18. **Engine starting controls**

(a) A twin-breech cartridge starter is fitted for each engine. They are operated by two guarded pushbuttons (126) on the starboard console panel. The guard switch, marked PORT—OFF—STBD. can be moved to expose one button at a time. When it is moved it operates a switch which energises the cartridge firing circuit for the exposed button. It must not be returned to OFF until the pushbutton has reset.

(b) Each pushbutton will only operate if the H.P. cock is ON and the throttle is at GROUND IDLE. Operation of the button then starts the following time sequence:—

Immediate	..	Cartridge indexed; ignition on; starting fuel pump starts (unless its master switch is off), starting jets start feeding.
After 2 secs.	..	Cartridge fires.
After 7 secs.	..	Ignition off; starting fuel pump stops; starting jets stop feeding.
After 15 secs.	..	Button re-sets.

The time sequence can be interrupted at any time by closing the H.P. cock.

(c) A spare cartridge is stowed in each main wheel well.

(d) Provision is also made for compressed air starting of the port engine only. The coupling for the air hose is forward of the nosewheel bay; access to it is obtained with the nosewheel doors closed or open. (See para. 33.)

19. **Engine relighting system**

The igniters may be used to relight an engine in flight by pressing the relight button on the top of the appropriate H.P. cock lever. The H.P. cock must be ON and the throttle fully closed to the GROUND IDLE gate (see para. 11).

20. **Engine instruments**

Oil pressure (78 and 81) and temperature (80) gauges are on the lower instrument panel. Two r.p.m. indicators (75), two shaft horsepower gauges (53 and 59) and a dual jet pipe temperature gauge (61) are on the instrument panel.

21. **Engine de-icing**

To be issued by amendment.

22. **Engine fire-extinguishers and warning lights**

(a) Two fire-extinguisher bottles are fitted, one in each wheel well. Three fire-extinguisher pushbuttons (39, 40 and 41), each incorporating a warning light, are on the port front panel and are marked PORT ENGINE, ENGINE BAY and STBD. ENGINE. The push-button (40) marked ENGINE BAY operates the extinguisher in the common engine compartment forward of the combustion chamber. The other two buttons (39 and 41) discharge the second extinguisher into the combustion chamber heat shield duct in the port or starboard engine according to which button is pressed. The lights will go out when the fire is extinguished. Spring-loaded fire access panels, giving direct access into the engine bay, are on each side of the engine cowling.

(b) Both fire-extinguisher bottles are fired automatically by the operation of a crash switch in the event of a crash landing. At the same time the crash switch isolates all electrical services. The crash switch is deleted by Mod. 417.

(c) The fire warning lights may be tested by gently pulling out the buttons, when the lights should come on. The buttons should then be allowed to re-set and must not be pushed in. When Mod. 329 is embodied the lights are tested by two pushbuttons (43) to the left of the fire-extinguisher buttons. One tests the centre light, the other tests the other two lights.

MAIN SERVICES

23. **Hydraulic system**

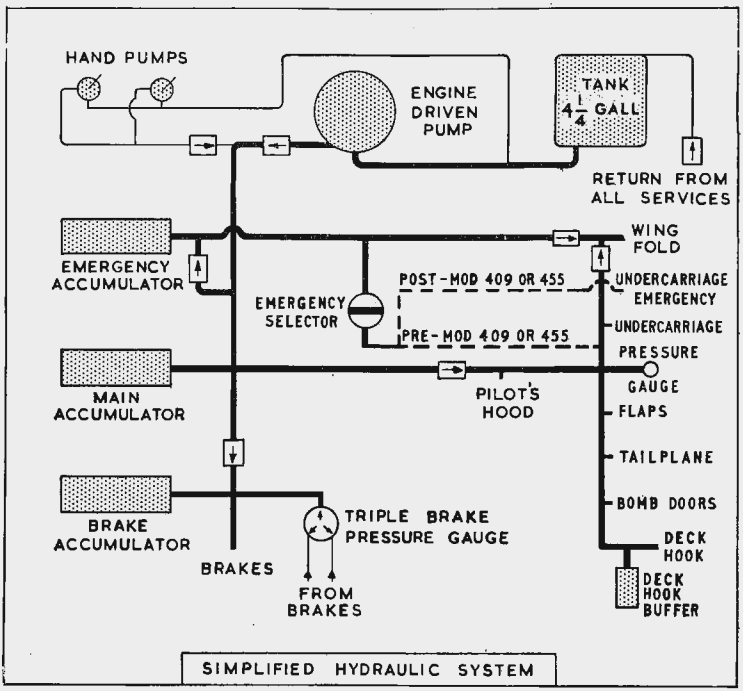
(a) An engine-driven hydraulic pump draws fluid from a $4\frac{1}{4}$ gallon tank in the fuselage immediately behind the pilot's headrest, and supplies power for operating the:—

Undercarriage
Flaps
Tailplane incidence

Wheel brakes
Bomb doors
Arrester hook
Pilot's Hood
Wing folding and spreading

(b) Two handpumps are fitted, one (90) in the cockpit to the right of the pilot's seat for use in flight, with a stowage (119) for the handle on the starboard side to the rear; the other is under the starboard retractable footstep for use during ground testing. Either of these pumps may be used to operate all services provided that the pipe lines are intact.

(c) There are three hydraulic accumulators in the system all of them being charged by the engine-driven pump.



SIMPLIFIED HYDRAULIC SYSTEM

NOTE.—In the above diagram the non-return valve shown to the left of the pilot's hood is Post-Mod. 276. Until this mod. is fitted its position on the diagram is to the right of the pilot's hood.

The main accumulator feeds all services at all times and also charges a deck hook buffer. The emergency accumulator normally supplements the wing folding and spreading; an emergency lever (64) on the starboard front panel enables the emergency accumulator to be made available for other services according to the modification state (see sub-para. (e) and (f)).

(d) The three accumulators and the hook buffer are initially charged with air, and the pressure gauges and charging points are grouped under a panel at the rear of the fuselage on the starboard side. Pressure release valves for the main and emergency accumulators, fitted above the air pressure gauges, enable all hydraulic pressure in these two accumulators to be released. The brake accumulator has no release valve and will remain charged when the others are discharged unless pressure is exhausted by operating the brakes.

(e) *Emergency hydraulic system (Pre-Mod. 409 or 455)*
If the engine-driven pump fails, pressure will remain available in the accumulators. The emergency accumulator may be made available to operate all services except the brakes (and the pilot's hood Pre-Mod. 276) by turning the emergency lever (64) on the starboard front panel clockwise through 90°.

(f) *Emergency hydraulic system (Post-Mod. 409 or 455)*
When Mod. 409 or 455 is fitted, operation of the emergency lever, as in sub-para. (e) above, makes the emergency accumulator pressure available *only* for operating the undercarriage by selecting the normal down or up pushbuttons.

(g) *Pressure gauges and indicators*
A pressure gauge (15) on the cockpit port wall shows the total pressure in the main system, or (Pre-Mod. 409 or 455) in the emergency system if this has been selected (see sub para. (e)). A triple brake pressure gauge (22), on the port console panel, shows the pressure available in the brake accumulator and the pressure at each wheel. The latter is restricted to 1,500 lb./sq. in., but when the parking brake is applied, the full available pressure is selected to each wheel and will not be shown on the gauge. Mod. 409 or 455 introduces a magnetic indicator on the starboard front panel below the bomb

bay tank indicator (74). This shows black when pressure in the emergency accumulator is above 2,100 lb./sq. in. and white when it is below this figure.

24. **Electrical system—24 volt**

(a) *D.C. Supply*

Two 6 kW generators, controlled through two voltage regulators, charge a battery and provide power for the electrical services. A voltmeter, and two pushbuttons labelled NO. 1 GENERATOR and NO. 2 GENERATOR, are in the rear cockpit on the port wall forward of the seat. The voltmeter normally shows the battery voltage, but by pushing either generator button, the voltmeter shows the generator output. Generator failure warning lights (65), one for each generator, are on the pilot's starboard front panel. These are duplicated in the centre and rear cockpits. Two NORMAL/RE-SET switches are in the rear cockpit, one on each wall. If a warning light comes on an attempt may be made to re-set the generator by putting the switch *of the live generator* to RE-SET for about two seconds and then returning it to NORMAL.

(b) *Battery control*

The guarded battery isolating switch (106) on the starboard console panel isolates the battery from the electrical services except the fire-extinguishers. An external supply socket is in the port wheel well, and when the ground battery plug is inserted, the aircraft battery and generators are disconnected from the system. When a ground battery is plugged in, the battery isolating switch should be set ON (forward) to prevent relay chatter.

(c) *Circuit-breakers*

Circuit-breakers are fitted in all three cockpits. Those in the pilot's cockpit are mounted on the starboard wall behind a cover plate (109). The circuit-breakers in the middle and rear cockpits protect the supplies to the equipment in these cockpits. The circuit-breakers in the pilot's cockpit protect the supplies to the other electrical services. The immediate action in the event of a power failure to any of the electrical services should be to press the circuit-breakers cover plate, thus resetting any circuit-breakers which may have tripped.

(d) *Flight instruments and auto-pilot supplies*

(i) A.C. for the Mk. 4B compass, the artificial horizon, the automatic jet pipe temperature control and the auto-pilot is supplied by a main and a stand-by inverter. Under normal operation, the main inverter supplies the flight instruments, and the stand-by inverter supplies the auto-pilot. In the event of failure of the main inverter, the stand-by inverter will automatically take over irrespective of whether the auto-pilot is switched on or not. A magnetic indicator (19) on the cockpit port wall shows black when the flight instruments are being supplied by the main inverter and white if the stand-by inverter has cut in. If the main inverter has cut out due to momentary overload or low D.C. voltage it can be brought back into circuit by pressing the change-over and test button (20) beside the indicator. If neither engine is running the voltage may be too low to operate *either* inverter and voltage should be built up before resetting. When the main inverter is running, if the pushbutton is pressed and held, the main inverter will cut out and the stand-by inverter will cut in. The pushbutton can, therefore, be used to check the operation of the stand-by inverter before flight.

(ii) When Mod. 358 is embodied, a switch (21) marked AUTO (forward) and STAND-BY is fitted on the cockpit port wall. It should normally be set at AUTO. If the automatic change-over to the stand-by inverter fails, the switch should be set to STAND-BY; this will switch in the stand-by inverter and switch out the main inverter. The switch may also be set to STAND-BY to check the operation of the stand-by inverter before flight.

(iii) A magnetic indicator (55) on the instrument panel to the right of the altimeter shows black when the flight instruments are being supplied by either the main or stand-by inverter, and white if both inverters fail.

(iv) The stand-by inverter normally supplies the auto-pilot but if the main inverter fails and the stand-by inverter takes over the supply to the flight instruments, the auto-pilot is automatically cut out. If

the auto-pilot is switched on when the stand-by inverter changes over, a magnetic indicator (60) on the top right of the instrument panel will show white.

(e) *Radar power supplies*

Three inverters supply power for the radar equipment. Additional inverters may be fitted if extra equipment, such as I.F.F. and Blue Silk, is carried. All radar inverters are under the control of the crew members and no controls or indicators are in the pilot's cockpit.

(f) *Alternator*

An engine-driven alternator, to be fitted later, will provide A.C. power for engine de-icing and 2,000 lb. store heating. It will be controlled by the alternator switch (at 118) on the starboard console panel.

AIRCRAFT CONTROLS

25. Flying controls

The flying controls are conventional, the rudder bar being adjustable for reach by a central star-wheel. Spring tabs are fitted to all flying control surfaces.

26. Flying controls locking gear

(a) The flying controls may be locked by a built-in locking system operated by a lever (115) in a quadrant on the starboard side of the cockpit rear bulkhead. A second lever (114) in the same quadrant is used to limit the throttle opening. The levers are interconnected so that it is not possible to lock the controls until the throttles are closed and locked, or to open the throttles until the flying controls are unlocked.

(b) To lock the controls, close the throttles to FLIGHT IDLE (GROUND IDLE if Mod. 125 is not fitted) and move the throttle locking lever to LOCKED (up), then move the flying control locking lever to LOCKED (up) and centralise the controls making small movements of the controls until the spring-loaded locks engage.

(c) The internal control locks may be applied whether the wings are folded or spread. The ailerons and aileron tabs are automatically centralised when the wings are folded.

27. **Trimming controls**

(a) The port elevator is fitted with a servo spring tab and the starboard elevator with a geared trim tab. A spring tab on each aileron is directly operated from the control column and aileron control rods, and a trim tab is fitted on the port aileron only. A dual-purpose spring and trim tab is fitted on the rudder.

(b) The rudder (32) and elevator (33) trim tabs are operated mechanically by handwheels, incorporating indicators, on the port console panel. The trim tab on the port aileron is controlled electrically by a spring-loaded switch (28) on the port console panel; an indicator (86) is on the port front panel.

28. **Tailplane incidence**

(a) The tailplane incidence is varied hydraulically when the flaps are operated, to reduce trim changes; the incidence decreases as the flaps move down, and vice versa. The movement of the tailplane is related to that of the flaps, so that it will assume a suitable incidence at intermediate flap settings.

(b) If the tailplane incidence control fails, the flaps will only operate up to about two-thirds of their full travel. If the flaps are lowered by the handpump the tailplane will not follow in synchronisation unless a pressure of 1,800 lb./sq. in. is first built up in the accumulator before making the flap selection. If the flaps have been lowered by the handpump, then as soon as the emergency accumulator is selected, Pre-Mod. 409 or 455, the tailplane may change incidence rapidly with a consequent change of trim.

29. **Flap control and indicator**

(a) The flap selector lever (30) moves in a serrated quadrant on the cockpit port side. Any setting between LAND and HOUSED (up) may be selected, and there is a gate at the optimum setting (about 20°) for going round again. When fully down the flaps are at about 40°.

(b) When the flap selector lever is in any position other than HOUSED, the wing folding lever is automatically locked. The flap selector lever is automatically locked when the wing fold lever is at FOLD. The flaps must

be fully housed before folding the wings, and the flap selector lever must not be moved when the wings are folded or when the bomb doors are in the "maintenance" position.

NOTE.—The interlock is between the levers and is not dependent on the position of the flaps. The wing fold lever must therefore not be moved until the flaps are fully up.

(c) A flap position indicator (86) is on the port front panel.

(d) Operation of the flaps automatically controls the incidence of the tailplane, the incidence being decreased as the flaps are lowered (see para. 28).

30. **Flap emergency operation**

If the hydraulic pump fails, pressure will still be available in the accumulator, but if this is discharged the pressure in the emergency accumulator can be made available, Pre-Mod. 409 or 455, by turning the emergency lever (64) on the starboard front panel. If this is also discharged, or if Mod. 409 or 455 is fitted, the hand-pump may be used, provided that the pipe lines are intact. In either case the hook should be lowered (if required) and the undercarriage locked down before an attempt is made to lower the flaps (see para. 120).

31. **Undercarriage controls and indicators**

(a) Two pushbuttons (48) to the left of the instrument panel operate the undercarriage selectors. The top button is red and is marked UP; the bottom button is green and is marked DOWN. A hinged safety cover can be moved to expose either button. The buttons must be pushed firmly until they are fully home. Sequence valves ensure that the nosewheel is locked down before the main wheels are disengaged from the up locks.

(b) A standard undercarriage position indicator (88) is below the port front panel.

(c) A red warning light (52), in the top left corner of the instrument panel, comes on if both throttles are closed

when all three wheels are not locked down; at the same time the red nosewheel light on the position indicator comes on.

(d) A forward facing light, below the nose of the aircraft, forward of the nosewheel, comes on when all three wheels and the deck hook are down. When the wheels and hook are down, the navigation lights will also come on provided that the external lights master switch is ON.

32. **Undercarriage emergency operation**

If the hydraulic pump fails, pressure will still be available in the accumulator, but if this is discharged the pressure in the emergency accumulator can be made available by turning the emergency lever (64) on the starboard front panel. If this is also discharged, the handpump may be used, provided that the pipe lines are intact (see para. 20).

33. **Nosewheel doors control**

For servicing, the nosewheel doors can be operated independently of the undercarriage by a lever on the outside of the fuselage above the starboard nosewheel door. They may also be opened in this way for compressed air starting if desired. The operating jacks are powerful and quick acting. The nosewheel doors *must* be closed before flight.

34. **Wheel brakes**

(a) The wheel brakes are controlled by two toe-buttons on the rudder pedals, and are operated by the aircraft hydraulic system through an independent hydraulic accumulator. Full differential braking is available by operating the required toe-button, irrespective of the position of the rudder bar. A separate parking brake (1) is fitted on the port side to the rear of the pilot's seat. This selects the full available pressure to both wheels; it is essentially a parking brake and should only be used in dire emergency when the aircraft is moving. The parking brake has only two positions; fully up to apply the brakes and fully down to release them. It is held in its selected position by its own friction and there is no lock. If the toe brakes fail due to lack of hydraulic power, so will the parking brake.

(b) A triple reading pressure gauge (22), on the port console panel, shows the pressure available in the brake accumulator and also the pressure at each wheel; it does not show the pressure at the wheels applied by the parking brake. The accumulator pressure is normally 2,500 lb./sq. in. and allows at least 15 full applications of the brakes if the pump has failed. In this event the pressure will fall to 1,550 lb./sq. in. as the brakes are used, *at which point the accumulator is discharged and pressure will drop rapidly to zero*. Thus, as the pressure falls towards 1,550 lb./sq. in. reliance should not be placed on the continued availability of the brakes; in emergency pressure may be applied by first pressing the toe-buttons and then operating the handpump.

35. **Nosewheel centring**

The nosewheel oleo is fitted with a cam to centre the wheels for retraction. A centrifugal clutch locks the two wheels together at speeds above 15 knots to prevent shimmy.

36. **Arrester hook**

A hook-shaped control lever (68) is on the starboard front panel. To lower the hook, the lever should be pulled out and turned a quarter turn either way. To retract the hook, the lever should be turned and pushed in. A green light (72) below the lever comes on when the hook is more than two-thirds down; when the aircraft is on the ground the hook does not lower enough to operate the light. On early aircraft a deck training switch is fitted below the lever.

37. **R.A.T.O.G.**

The R.A.T.O.G. master switch (47) and jettison button (46) are on the port front panel. The firing button (14) is on the starboard throttle lever; it will only operate when the master switch is on.

38. **Wing folding**

(a) Before the wings are folded it is essential that the flaps are fully housed, and the control column unobstructed. The wings may be folded or spread by the engine-driven hydraulic pump, the accumulators, either handpump or by power from a hydraulic ground rig. Folding or spreading is permissible with full fuel tanks

and with armament stores on the wing stations. The ailerons and aileron tabs are automatically centralised when the wings are folded.

(b) The wing fold selector lever (3) is fitted at the rear of the cockpit to port of the pilot's seat and has three positions FOLD—NEUTRAL—SPREAD. A safety lever (2) is below it. The selector lever cannot be moved from the FOLD or NEUTRAL positions when the safety lever is at SAFE, but only when it has been moved to FREE. The safety lever will move automatically to SAFE when the selector lever is set to SPREAD, but must be set to SAFE manually if the selector lever is to be left at FOLD. The selector lever can be moved from SPREAD to NEUTRAL when the safety lever is at SAFE. Mechanical latch pin indicators are fitted in the wings inboard of the inner and outer wing hinge points; these lie flush with the skin when the jacks which operate the latch pins are in the "engage" position. In addition, at each wing fold there is a red light. All lights are out when the wings are spread and the latch pin operating jacks are fully engaged; they show red individually when the wing hinge and latch pin to which they refer are not fully spread and locked. A spring-loaded switch (29) on the port console panel enables all four lights to be tested when the wings are fully spread and locked.

NOTE.—On early aircraft without Mod. 33 all four lights come on if any wing hinge is not fully spread and locked. There is no test switch but a magnetic indicator at the rear of the port console panel shows white if there is a failure in the warning circuit.

(c) *Safety interlocks*

(i) The selector lever cannot be moved to FOLD unless the flap lever is at HOUSED.

(ii) Retraction of the nosewheel will automatically move the selector lever to NEUTRAL if it has been left in the SPREAD position.

39. **Auto-pilot**

(a) *Limits*

(i) The Mk. 11 auto-pilot provides stabilisation in the roll, pitch and yaw axes, together with facilities for

controlled rates of climb or dive up to 2,500 ft./min., and co-ordinated turns with up to 70 degrees of bank.

(ii) The auto-pilot may be engaged in any attitude within the limits of 70 degrees of bank and a vertical speed of 2,500 ft./min., and thereafter will maintain the aircraft in that attitude provided that normal power for that condition is maintained.

(iii) The aircraft is subject to a limiting indicated air speed of 200 knots when the auto-pilot is engaged.

(b) *Description*

(i) The auto-pilot comprises the following controls and indicators in the front cockpit:—

1. A master switch (36), on the port console panel, which makes the electrical supply to the auto-pilot.
2. Magnetic indicator (60) on the instrument panel This shows black when the auto-pilot is switched OFF or functioning correctly. It shows white if the auto-pilot is disengaged for any reason while still switched ON.
3. A controller (37) on the port console panel, which carries:—

   A controller switch marked ON, STAND-BY and OFF.

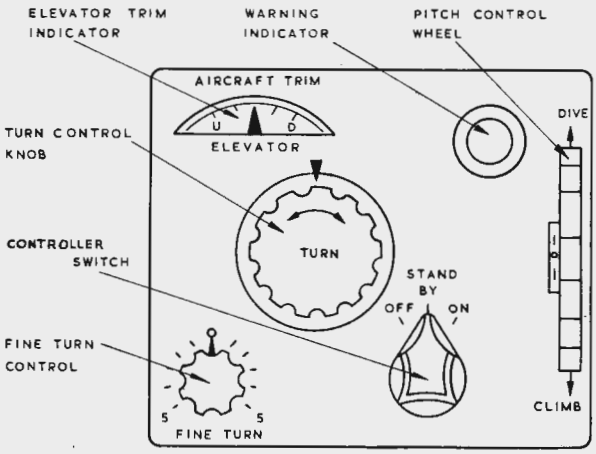
   A magnetic indicator which shows black or white, and when it is white the word ON appears.

   A TURN control which enables co-ordinated turns with angles of bank up to 70 degrees to be selected.

   A FINE TURN control which gives changes of heading up to about 3 degrees.

   A pitch control which enables climbs or dives of up to a vertical rate of 2,500 ft./min., to be selected.

   An elevator trim indicator which indicates the load on the elevator servo; i.e. the out-of-trim force on the control column which would normally require to be trimmed out, but which the auto-pilot is holding.



AUTO—PILOT CONTROLLER

4. A pump reset button (11) on the cockpit port wall, which starts the hydraulic pump.
5. An emergency cut-out button on the control column.

In addition, an altitude control is in the centre cockpit.

(ii) Electrical supply for the auto-pilot is provided by the flight instruments stand-by inverter. If the normal inverter fails, the stand-by inverter will be automatically switched to the flight instruments and will not be available for the auto-pilot. If this happens when the auto-pilot is engaged or at STAND-BY, a magnetic indicator (60) on the top right of the instrument panel shows white.

(iii) The auto-pilot is an electro-hydraulic system with independent hydraulic supply. Attitude and heading reference data is provided by the pilot's Horizon Gyro and the Gyro Unit of the Mk. 4B Compass. With the auto-pilot switched OFF the servomotors move freely with control movement; on switching to STAND-BY and pressing the re-set button the hydraulic pump starts to run and the servomotors are locked into the control run;

the damping effect of the hydraulic fluid in the servomotors can be felt when the controls are moved.

(iv) Limit switches are incorporated in the elevator and aileron circuits to prevent excessive control deflection in the event of an auto-pilot runaway. If the limit switches operate, the auto-pilot will be thrown out of circuit and the magnetic indicator (60) on the instrument panel will show white. This may also happen if excessively violent manoeuvres are made with the auto-pilot engaged.

(v) The limit switches can be overridden by pressing and holding the pump re-set button. This should only be done for ground checking in gusty conditions, when the control surfaces may be difficult to keep within the limit switch tolerances.

40. **Flight instruments**

(a) *A.S.I. system*

The pressure head is under the port wing and a static vent is on each side at the rear of the fuselage. The pressure head heater is automatically switched on when the undercarriage down-locks are broken, and switched off when the undercarriage is down. An override switch (50) on the instrument panel may be used to switch on the heater when the undercarriage is down.

(b) *Mk. 4B compass*

The Mk. 4B compass is supplied by the flight instruments inverter with an emergency stand-by having automatic changeover. The master indicator is in the centre cockpit and a gyro unit is on the pilot's instrument flying panel. A compass/D.G. switch (79) is on the instrument panel, to the right of the gyro unit.

(c) *Magnetic stand-by compass*

An E2A magnetic stand-by compass is on the starboard winsdcreen arch. When the gyro weapon sight is raised, the compass is affected and becomes unreliable.

(d) *Horizon gyro*

(i) The horizon gyro has a fast erection pushbutton (56) below and to the left of it. The instrument is

not self-erecting when first switched on, unless the horizon bar is within 10° of horizontal in the roll sense. After the engines have been started the fast erection button must, therefore, be pushed in and held until the horizon bar falls well within these limits. This may take some 10 seconds. Self-erection within the 10° limits is slow; about 5° per minute.

(ii) If the gyro is toppled in flight, the aircraft must be flown level by reference to the other instruments before the fast erection button is pressed. The gyro will not topple in roll, but only if 80° of climb or dive is exceeded.

(e) *Outside air temperature gauge*

An outside air temperature gauge (6) is on a bracket at the rear of the cockpit port wall. An additional gauge is on the instrument panel in the centre cockpit.

COCKPIT EQUIPMENT

41. **Entry to cockpits**

A retractable footstep on the starboard side of the fuselage above the nosewheel door, and a number of hand/foot holds provide access to the cockpit. A walkway along the top of the wing root and hand-holds below the hood rails allow access to the centre and rear cockpits. The footstep drops automatically when the lower hand/foot hold is depressed, but it must be manually stowed before flight.

42. **Pilot's hood**

(a) The pilot's hood is opened and closed hydraulically by a lever (87) on the port front panel. The lever should be pushed forward to close the hood and pulled back to open it. The lever may also be set to neutral to retain the hood in any desired position. An external lever, just above the retractable footstep on the starboard side, may be used to open or close the hood hydraulically from the ground. If the cockpit lever is turned through 90° when the hood is opened, the external lever is inoperative, thus preventing inadvertent operation.

(b) The pilot's hood may be jettisoned by pulling out the control (63) on the starboard front panel. An external jettison lever is also fitted below the hood on the starboard side. Tests have shown that the hood should jettison satisfactorily at speeds between 115 and 240 knots. If the jettison lever has been operated a small mechanical indicator (110) on the rear bulkhead on the starboard side shows red, even if the hood has not actually jettisoned. It normally shows green.

(c) A micro-switch under the port hood rail operates the weapon sight retraction system when the hood is jettisoned, thus retracting the sight to give greater clearance for abandoning.

43. **Observers' hoods**

(a) The observers' hoods are opened and shut manually. An automatic lock holds each hood fully open or closed, and may be released by either the internal or external handle fitted below each hood on the starboard side. When opening or closing either hood, the internal handle should spring into the LOCKED position by itself. Both hoods may be opened in flight up to 130 knots, but care should be taken to prevent them running away and slamming open.

(b) The observers' hoods may be jettisoned by pulling out the jettison handles fitted at the front of the centre cockpit and at the rear of the rear cockpit. External jettison levers are fitted below the hoods on the starboard side. Tests have shown that the hoods should jettison satisfactorily at speeds between 115 and 240 knots, though there is a slight risk of the rear hood hitting the fin at the lower speed. Indicators performing similar functions to that in the pilot's cockpit, are fitted in the centre and rear cockpits.

44. **Pilot's seat adjustment and shoulder straps release**

A lever (122) on the right of the pilot's seat enables the height to be adjusted. The shoulder straps release lever (113) is on the rear bulkhead to the right of the seat. It is *not* spring-loaded to the locked position. A harness stowage fitting (9 and 104) is on each side of the cockpit.

45. **Pilot's headrest**

The pilot's headrest may be adjusted forward and aft by a trip lever on the headrest.

46. **Cockpit heating and windscreen de-misting**

(a) Hot air for heating the three cockpits and for de-misting the pilot's windscreen is supplied from both engines. A cock (124) to starboard of the pilot's seat controls the supply of hot air according to the setting of the cock which is marked DM ON, ALL ON, ALL OFF, C/PITS ON. These positions supply the hot air respectively to the windscreen de-misters only, all three cockpits and windscreen, all off, three cockpits only. The temperature of the supply in each cockpit is controlled by varying the amount of cold air, this being fed into each cockpit from external scoops. The cold air supply to each cockpit is controlled individually by a lever, that (92) for the pilot being on the starboard wall. The hot air distributors for the windscreen can be turned to direct the air on to the front or side panels. They should not be directed at right angles on the glass when the windscreen is very cold.

(b) Each cockpit also has a separate adjustable cold air vent, each supplied from an external scoop. The pilot's cold air vent (94) is on the cockpit starboard wall.

47. **Oxygen system**

A single oxygen cylinder in the rear of the fuselage, supplies oxygen to the pilot only, through an economiser and a Mk. 11C regulator (67) to starboard of the instrument panel. The supply lasts for about 2 hours at HIGH flow.

48. **Cockpit lighting**

(a) Ultra-violet lighting for the instrument panel is controlled by an ON/OFF dimmer switch (105) on the starboard wall. There is no master switch.

(b) Red floodlighting of the instrument panel and the port and starboard sides of the cockpit is controlled by two master switches (at 120) on the starboard console panel and three dimmer switches (107, 108 and 111) on the starboard wall. A wandering lead and lamp (99) is recessed in the starboard console panel and is controlled by a switch (100) beside it.

(c) Emergency white lighting of the instrument panel is provided by separate lights supplied from an independent dry battery and controlled by a guarded switch (at 120) on the starboard console panel.

49. **External lighting**

(a) A master switch (123) on the starboard console panel must be set to ON before any of the external lights will function.

(b) Individual switches (at 121) on the starboard console panel control the navigation, identity and formation lights. Each has a STEADY—OFF—MORSE switch, and the formation and navigation lights have in addition a DIM—BRIGHT switch. If the master switch is ON, the navigation lights come on when the hook is down and the undercarriage is locked down.

(c) Taxying lamps in the leading edge of the outer wings are controlled by a switch (42) on the port front panel.

(d) Until it is deleted by Mod. 117, a landing lamp is fitted under the port wing. It is controlled by a three-position HIGH, OFF, LOW switch on the cockpit port side above the wing locking lights test switch (29).

(e) On early aircraft a deck training switch is on the starboard front panel below the hook control. When this switch is ON and the nosewheel is locked down a forward facing light on the nosewheel is illuminated and the green hook light on the starboard front panel comes on.

50. **Windscreen wiper**

The electro-hydraulically operated windscreen wiper is controlled by an OFF—SLOW—FAST switch (73) on the starboard front panel. Pre-Mod. 114 it is controlled by a lever at the bottom right-hand corner of the windscreen and a FAST—SLOW switch on the starboard front panel.

51. **Windscreen de-icing and de-greasing system**

On aircraft embodying Mod. 94, a small tank of about 5 pints capacity contains fluid for de-icing or de-greasing the windscreen. The fluid is sprayed on to the screen by an electric pump controlled by a pushbutton (69) on the starboard front panel. The pump runs as long as the button is depressed.

52. **Pilot's notes stowage**

A stowage (26) for pilot's notes is on the port side of the cockpit.

53. **Miscellaneous emergency equipment**

(a) *Signal pistol.* A signal pistol is in the centre cockpit. The stowage is on the floor to starboard of the seat and the firing position is on the port wall below and forward of the hood rail. Cartridges are stowed on the bulkhead on both sides, above and behind the seat.

(b) *Hand fire-extinguishers.* Two hand fire-extinguishers are fitted; one in the middle cockpit on the left of the seat and one in the rear cockpit on the starboard wall beside the seat.

RADIO AND RADAR EQUIPMENT

54. **Radio altimeter**

The radio altimeter (82) is on the instrument panel and incorporates a switch. The range is from 0 to 400 ft. The instrument should not be used unless Mod. 76 has been incorporated.

55. **V.H.F. and intercom. (ARI 5491)**

(a) The controller (38) for the two V.H.F. sets on the port console panel selects either set individually or both on DUAL or RELAY.

(b) In the middle cockpit is a selector marked VHF/H.F./SONO-i/c/ZBX, and in the rear cockpit a selector marked VHF/HF/SONO-i/c. Normal intercom. through the V.H.F. sets is available between all three cockpits when the crew members' selectors are at V.H.F. and the pilot's controller at No. 1 or No. 2 set.

(c) An intercom. amplifier is controlled by an ON/OFF switch below the port hood rail in the rear cockpit and when switched ON, provides intercom. if the crew members selectors are at SONO-i/c. A panel in the middle cockpit carries three buttons marked LISTEN TO PILOT, TALK TO CREWMAN, and TALK TO PILOT. A similar panel in the rear cockpit has three buttons marked TALK TO OBSERVER, LISTEN

TO PILOT, and TALK TO PILOT. When the crew members are both selected to SONO-i/c and the amplifier is on, they can speak to each other by pressing the appropriate button without being heard by the pilot. By pressing the LISTEN TO PILOT button either crew member can monitor the pilot's V.H.F. system and, if convenient, can then call the pilot by pressing the TALK TO PILOT button.

(d) The pilot has a CALL CREW button (44) on the port front panel, which enables him to talk to the crew regardless of the position of their selectors. They can, however, only reply by selecting SONO-i/c and pressing the TALK TO PILOT button.

(e) In the event of failure of the V.H.F. sets, intercom. will still be available through the amplifier as above, provided it is ON.

(f) A V.H.F. press-to-transmit button is on the control column and there is one in both the other cockpits. A spring-loaded mute switch (45) is on the port front panel and there is also one on the floor of the other cockpits. Two R/T sockets are in the pilot's cockpit; one on the front of his seat and one above his left shoulder.

(g) An external intercom. socket is under a flap on the port side of the fuselage above the front of the bomb door.

56. **ZBX (ARI 5307)**

The ZBX controller (112) and ZBX/VHF mixer box (117) are at the rear of the starboard console panel.

57. **IFF (ARI 5848)**

The IFF control panel (125) is on the starboard console panel. The master switch (102) is on the wall above the control panel. On early aircraft IFF (ARI 5679) is fitted. The control panel and "F" switch are at the rear of the port console panel, and the "D" switch is further forward on the same panel.

58. **Radome**

(a) The radome is operated electrically and is controlled from the A.S.V. panel on the port wall in the middle cockpit. To raise or lower the radome the A.S.V.

master switch must be on and the flap over the radome operating switch must be open in the FLIGHT position. The operating switch is spring-loaded and must be held down to lower the radome, and up to raise it. Indicator lights on the panel show green when the radome is fully housed, red when it is fully down, and red and green when it is in an intermediate position. When the flap over the switch is open and the radome is down or not fully housed, lowering the undercarriage will automatically raise the radome.

(b) A magnetic indicator (51) on the pilot's instrument panel shows black when the radome is housed and white in any other position. A shielded switch (at 120) on the starboard console panel can be used to raise the radome in emergency through a separate circuit; the radome is raised to a safe position for landing, but not fully, so the pilot's indicator will remain white.

(c) For maintenance, a radome operating switch is provided in the fuselage behind an access panel aft of the radome. There is insufficient ground clearance to lower the radome fully.

59. **A.S.V. 19B**

This equipment is under the control of the observer.

60. **Sonobuoys**

Sonobuoys are carried under the wings or in the bomb bay. They are selected by the observer but released by the pilot's control column firing switch. An indicator (95) on the starboard side shows white when the sonobuoys are selected. Pre-Mod. 114 the indicator is on the starboard front panel.

ARMAMENT

61. **Bomb doors**

(a) The selector lever (66) for the hydraulically operated bomb doors is on the starboard front panel and a magnetic indicator (96) on the starboard side shows white when the bomb doors are fully open, and black when they are closed or in an intermediate position. Micro switches on the doors ensure that internal stores

cannot be dropped or jettisoned until the doors are fully open. Pre-Mod. 114 the indicator is on the starboard front panel above the selector lever.

(b) For maintenance and loading stores the bomb doors can be opened beyond the normal open position by disconnecting them from the jacks and hooking them back by a cable in each wheel well. With the doors in this position the flaps must not be operated.

62. **Armament release**

An armament release switch is on each control column. This fires or releases all stores according to the settings on the individual selectors. The switch also has a safety cover which allows the G.45 camera to be operated independently of the stores.

63. **Weapon sight**

(a) The retractable gyro weapon sight (57) is mounted above the centre of the instrument panel. The master switch (54) is to the left of the sight; it controls the raising and retracting of the sight and also the electrical supply to the sight. The selector dimmer control (10) is on the cockpit port wall. A stowage (18) for spare filaments is on the cockpit port wall. A fuse (83) in the weapon sight retraction circuit is in a screw-in fitting below the instrument panel.

(b) To provide greater clearance for escape, the weapon sight is automatically retracted when the front cockpit hood is jettisoned. An emergency retraction knob (58), to the right of the sight, may be pushed to retract the sight if the normal retraction system fails.

64. **Bombing controls**

Bombs are carried in the bomb bay and are released by the control column firing switch when the bombs/R.P. selector switch (49) on the left of the instrument panel is at BOMB. The spacing unit (97), fusing selector (101) and jettison pushbutton (98) are on the cockpit starboard wall.

65. **R.P. controls**

R.P.s are carried under the wings and are fired by the control column firing switch when the bombs/R.P. selector switch

(49) on the left of the instrument panel is at R.P. The R.P. selector switch (34) is on the port console panel.

66. **2,000 lb. store**

A 2,000 lb. store may be carried in the bomb bay; it is selected by a switch (71) on the starboard front panel and released by the control column firing switch. It is controlled by a master switch (at 118) on the starboard console panel. This must be switched on before take-off and left on until the store has been released.

67. **Markers and flares**

The markers and flares are carried in the rear fuselage and are controlled by the observer. The pilot has a marker flare fusing switch (70) on the starboard front panel.

68. **G.45 camera**

The G.45 camera is controlled by a single ON/OFF switch (at 118) on the starboard console panel. With this switch ON the camera can be operated by the camera switch or the shielded firing switch on the control column. An aperture switch (at 118) is on the starboard console panel.

69. **Stores jettisoning controls**

(a) There are two jettisoning controls in the cockpit; a guarded pushbutton (98) labelled BOMB JETTISON, on the starboard wall, and a guarded switch (103), labelled JETTISON ALL EMERGENCY, also on the starboard wall. The pushbutton, when pressed, releases all stores in the bomb bay provided that the bomb doors are open. The emergency jettison switch, when set on, immediately jettisons any stores under the wings except R.P. and also all stores in the bomb bay if the bomb doors are open. R.P. are cleared in the normal manner, and the markers and flares in the rear fuselage are jettisoned by a pushbutton in the centre cockpit.

(b) The bomb bay tanks, when fitted, are jettisoned in the same way as stores in the bomb bay.

PART II

LIMITATIONS

70. Engine limitations—Double Mamba 100

	R.P.M.	J.P.T. °C.
Take-off and operational necessity .. .. (10 mins. limit per flight)	15,000 ± 100	590 (Note 1)
Maximum continuous ..	15,000 ± 100	540
Ground idling	8,000 min. on starting	520 (Note 2)

NOTE 1.—The auto j.p.t. controller (see para. 15) is set to a datum of 580° C. ±5° C. If the controller fails, the temperatures must be kept within limits by use of the throttles.

NOTE 2.—Engines must never be run below 8,000 r.p.m. The ground idling r.p.m. depend on the oil inlet temperature and head wind. With both engines running, oil inlet temperature 50 to 60° C., and a head wind component of not more than 10 knots, the ground idling r.p.m. should be 9,400 ±200. (See para. 87.)

Shaft Horse Power (indicated):—

Max. in flight at 15,000 r.p.m. ..	1,350 S.H.P.
Max. during warming up	800 S.H.P.

NOTE.—Until Mod. 78 is incorporated the S.H.P. gauges under-read by about 50 S.H.P. at 15,000 r.p.m., and the maximum indicated S.H.P. in flight is therefore 1,300.

Oil pressures

Maximum at 15,000 r.p.m.	90 lb./sq. in.
Normal at 15,000 r.p.m.	70 lb./sq. in.
Minimum at 15,000 r.p.m.	50 lb./sq. in.
Minimum below 15,000 r.p.m.	25 lb./sq. in.

Oil temperatures (inlet)

Maximum	90° C.
Minimum for certain starting using double cartridge—para. 81	−8° C.

NOTE.—Ground starting may be attempted at temperatures below −8°, but a successful start on two cartridges becomes less certain as temperature decreases.

Minimum for opening up for windmill starting only	5° C.
Minimum for take-off	25° C.

71. **Flying limitations**

(a) The aircraft is cleared for operation from airfields and carriers, by day and night, in temperate and tropical climates. Intentional spinning, aerobatics and violent manœuvres must be avoided. There is no provision for fuel or oil supply under conditions of negative G.

(b) *Maximum speeds (knots)*

Flaps housed		360
Flaps fully down		135
Undercarriage down		175
Radome down		300
Hoods open	Rear	130
	Middle	130
	Front	175
Bomb doors open		300
Auto-pilot engaged		200

NOTE.—The maximum speeds quoted for operation of a service also apply when the service is in the extended position.

(c) *Maximum all-up weights*

For normal take-off and catapulting	19,600 lb.
Overload take-off and catapulting	21,600 lb.
For carrier and airfield landings	19,800 lb.
For overload carrier and airfield landings (emergency only)	21,500 lb.

(d) *C.G. range* (undercarriage down)

108 in. to 116 in. aft of datum.

PART II—LIMITATIONS

72. **Armament limitations**

The tables at Appendix I detail the stores which may be carried in the various roles, together with the conditions of carriage and release.

PART III

HANDLING

MANAGEMENT OF SYSTEMS AND EQUIPMENT

73. **Management of the fuel system**

(a) Fuel from the wing tanks is automatically transferred to the fuselage tank by air pressure from the compressors of both engines. There is sufficient pressure available from one engine to give full rate of transfer. The bomb bay tanks, if carried, transfer their contents first, followed by the outer and then the inner wing tanks. When fuel is being transferred or when air pressure is sufficient for transfer, the appropriate magnetic indicator shows black. When any tank is empty or there is insufficient air pressure to transfer, the appropriate magnetic indicator shows white. Fuel will not necessarily transfer evenly from both sides.

(b) The level of the fuel in the main tank should not fall below 800 lb. until both pairs of wing tanks are empty or have stopped transferring. If the fuel level falls much below 800 lb. before the wing tanks are empty, it is probable that, due to a fault in the transfer system, the contents in the main tank only will be usable.

(c) If the booster pump fails, both recuperator magnetic indicators (if fitted) will show white. However the gravity by-pass should allow sufficient flow for full engine requirements. If only one magnetic indicator shows white it denotes a fault in the recuperator. If Mod. 204 (fuel recuperators) is not fitted, there will be no visual warning of booster pump failure.

(d) There are no negative G traps in the oil or fuel system, thus negative G in excess of 4 seconds will result in flame-out on either or both engines with possible oil starvation and fuel aeration.

(e) Fuel may vent in small quantities from the mid-wing tanks while these are full.

74. **Engine handling**

(a) *Automatic J.P.T. control units*

The j.p.t. control selector switch for each engine should always be switched to NORMAL except for cartridge starting and in emergency (see para. 117).

(b) *Flight fine pitch stop*

The flight fine pitch stop switches should be selected to NORMAL at all times except in emergency (see para. 114).

(c) *Starting fuel pump master switch*

The starting fuel pump master switch should be ON at all times except after a failure to start (see para. 86).

(d) *Handling during starting*

Engine handling during starting is covered later in the Notes (see para. 81 to 86).

(e) *Engine handling while taxying*

Harsh throttle movements should be avoided, particularly at throttle settings below 15,000 r.p.m. or when the oil temperature is low. It is most important that opening of the throttles between the ground idle and flight idle positions be done slowly, special care being taken to prevent the throttle position becoming too far in advance of the engine r.p.m. Also, the throttle must not be moved beyond the flight idle gate until the r.p.m. have stabilised. It is recommended that, consistent with operational requirements, as much taxying as possible be carried out on one engine.

(f) *Engine handling in flight*

WARNING.—Shaft horse power must not be allowed to exceed 1300 indicated at any time.

(i) In the air, the throttles must not be closed beyond the flight idle gate except when relighting.

(ii) The engines will constant speed at 15,000 r.p.m. $\pm$ 100 under all normal conditions of flight. The r.p.m. may fall below this figure if speed is reduced to below 140 knots with the throttles closed to flight idle and the undercarriage up (flight fine pitch stops engaged). If the stops are withdrawn, e.g., the undercarriage is lowered, under these

conditions there will be a rapid increase of r.p.m. and drag, with a nose-down trim change. Thus the undercarriage should not be lowered at speeds below 140 knots unless each engine is producing at least 200 S.H.P. If the r.p.m. have fallen below 15,000 with the flight fine pitch stop engaged, the throttle must be opened smoothly until constant speeding r.p.m. are achieved.

(iii) Throttle movements should normally be smooth and unhurried. In emergency, the throttles may be slammed open, and the delay mechanism will ensure that power is applied progressively.

(iv) *Engine handling in icing conditions*

Engine icing is known to occur in the same conditions which produce airframe icing. The first sign of engine icing is a reduction in shaft horse power, followed by a rise in j.p.t. and possibly vibration. Should these symptoms be evident:—

1. Start the second engine if one is stopped.
2. Reduce power and endeavour to fly out of icing conditions.

NOTE.—It may not be possible to relight an engine if it is iced up.

(v) *P.C.U. failure*

Engine handling in the event of P.C.U. failure is covered in para. 113.

75. **Management of the electrical system**

(a) When starting with an external power supply, turn the battery isolation switch ON to avoid relay chatter.

(b) If any electrical service should fail, press in the circuit-breaker cover plate to reset any circuit-breakers which may have tripped.

(c) After start up, check that the generator warning lights are out and the main inverter magnetic indicator is black. If the latter is white press the change-over and test button beside the indicator. Check the flight instruments magnetic indicator is black.

(d) *Resetting the generators*

Failure of a generator will be indicated by one of the warning lights on the starboard front panel. The lights are duplicated in the centre and rear cockpits. If a

warning light comes on, an attempt should be made to re-set the generator from the rear cockpit by selecting the *live* generator re-set switch (*not* the one that has failed) to RE-SET for about 2 seconds and then returning it to NORMAL.

(e) *Flight instruments inverters*

The flight instruments main and stand-by inverters should be checked before flight. When the engines are running, the main inverter will normally be operating; to check the stand-by inverter press and hold the change-over and test button (20) on the port wall, and check that the stand-by inverter functions correctly. If Mod. 358 is fitted, also check for correct functioning by setting the AUTO STAND-BY switch to STAND-BY for a short time, afterwards returning it to AUTO. If the main inverter fails in flight, an attempt should be made to re-set it by pressing the change-over and test button. If the main inverter fails completely and the stand-by inverter does not automatically take over the supply, the AUTO STAND-BY switch (if fitted) should be set to STAND-BY.

76. **Management of the hydraulic system**

(a) In flight, the hydraulic pressure should be between 2,100 and 2,600 lb./sq. in., the cut-in and cut-out pressures respectively. In flight, with no services selected, the main hydraulic pressure may fall from the cut-out to the cut-in pressure in as little as 3 to 4 minutes. This is satisfactory, but if the time interval falls to a minute or less, an internal or external leak should be suspected. Pressure should be checked frequently and the fault reported on landing. It should be noted that the gauge reads hydraulic pressure and that as the main and emergency accumulators are charged to 1,250 lb./sq. in. air pressure and the brake accumulator to 1,550 lb./sq. in. air pressure the hydraulic pressure must always be substantially above this for there to be power available.

(b) Pre-Mod. 409 or 455, the emergency accumulator may be made available to operate all services except the brakes (and, Pre-Mod. 276, the pilot's hood) by turning the emergency lever clockwise through 90°. When Mod. 409 or 455 is fitted, the emergency accumulator may be

made available only to operate the undercarriage. Pre-Mod. 409 or 455, the emergency accumulator, when full, contains sufficient fluid to lower the hook, undercarriage and flaps once only. If, or when, the accumulators are exhausted, pressure may be built up again by the handpump. Operation of the handpump will charge all three accumulators and will operate all services which have been selected. It is therefore possible to operate any service by either selecting that service and pumping, or by charging the accumulator and then selecting the service in the normal way. Using the former method, only one service at a time should be selected, but this method must not be used for the undercarriage which should not be selected down with a pressure of less than 2,000 lb./sq. in. in the system (see para. 120). It will be appreciated that successful operation of the handpump is dependent on fluid being available and the pipe lines being intact; however, if a pipe line (or jack) is leaking on the "service" side of the selector cock, the rest of the system will still operate as long as the broken service is not selected.

(c) If Mod. 409 or 455 is not embodied, functioning of the emergency selector should be checked after starting the engines. The pressure gauge will show the emergency pressure when the lever is turned, though it may only just flicker if pressures are equal. After this check the lever must be returned to normal. If Mod. 409 or 455 is embodied, a check should be made, after starting the first engine, that the magnetic indicator for the emergency accumulator goes black when pressure reaches 2,100 lb./sq. in.

(d) For action to be taken in the event of failure of the hydraulic pump, see para. 120.

77. **Management of the auto-pilot**

(a) *Checking before flight*

The following checks should be made before flight, with the engines running, if the auto-pilot is to be used:—

(i) Check that the flight instruments appear to function correctly on both the normal and standby inverters. This must be done with auto-pilot disengaged.

(ii) Switch on the auto-pilot master switch.

(iii) With the controls neutral, move the controller switch to STAND-BY. Check that the TURN control moves initially to maximum starboard turn and the pitch control to maximum dive, and that both controls finally settle at approximately zero, the position of the turn control being dependent upon the aircraft's lateral attitude.

(iv) Press the pump re-set button. Check that the load on the controls increases slightly (more noticeable on the ailerons), thus indicating that the hydraulic pump is working normally.

(v) When the controller switch is set to STAND-BY, and the pump re-set button is pressed, check that the magnetic indicator (60) on the instrument panel goes white, and after a short delay, returns to black.

(vi) After the TURN and pitch controls have moved to zero, move the controller switch ON. There will be a slight kick on the control column, the controls will harden, and the indicator on the pilot's controller should show white (on).

(vii) With the auto-pilot engaged, press the emergency cut-out button; check that the controls become free immediately and that the indicator on the instrument panel goes white.

(viii) Move the controller switch OFF. The indicator on the instrument panel should go black.

(ix) If the auto-pilot trips out, thus denoting a fault in the system, or if the indicator on the instrument panel shows white, switch OFF the auto-pilot master switch and investigate the reason.

(x) Switch OFF the auto-pilot master switch before take-off.

NOTE.—If wind conditions are such that the elevator and ailerons are moving sufficiently to cause the limit switches to operate, hold the pump re-set button in during ground testing.

(b) *After take-off*
As soon as convenient after take-off, switch the auto-pilot master switch ON and set the controller switch to STAND-BY.

(c) *Engaging the auto-pilot in flight*
(i) Check that the normal inverter is still operating the flight instruments and that the aircraft is in trim.
(ii) Press the pump re-set button; be prepared for an increase in weight and slight displacement of the controls.
(iii) After about one minute, check that the TURN and pitch controls have moved to their correct positions, i.e. the TURN control indicates the lateral level of the aircraft and the pitch control indicates the vertical speed of the aircraft. The pitch control may take longer to move to its correct position if the auto-pilot is to be engaged after a sustained climb.
(iv) If the auto-pilot controls are correctly aligned, switch the controller switch ON. There will be a kick on the control column, the control forces will harden and the aircraft will maintain its original flight path. The indicator on the pilot's controller will show ON.

(d) *Level flight*
To obtain straight and level flight, set the TURN and pitch controls to zero. The aircraft will then maintain barometric height on a course monitored by the Mk. 4B compass.

(e) *Turning*
(i) To turn, move the TURN control to the desired angle of bank. On approaching the new course, return the control to zero. The control is sensitive and should be used with care.
(ii) The FINE TURN control alters the aircraft heading up to three degrees. This control is returned to neutral on the next operation of the main TURN control.

(f) *Climbing and diving*
Move the pitch control until the desired rate of climb or descent is achieved.

(g) *Trim indicator*

The elevator trim should be adjusted as necessary throughout the flight to keep the trim indicator needle in the safe zone. *This is important because it affects the runaway safeguards.*

(h) *Disengaging the auto-pilot*

(i) Check that the trim indicator needle is in the safe zone, and trim the elevators if necessary until the needle shows zero out-of-trim.

(ii) Switch the controller switch to STAND-BY. The controls should become free and the indicator on the pilot's controller should go black. The indicator on the instrument panel should remain black. The hydraulic pump will continue to run and the auto-pilot may be re-engaged immediately if desired.

(iii) For longer periods of disengagement the emergency cut-out button can be used. This stops the hydraulic pump but allows the electrical follow-up system of the auto-pilot to remain in operation.

(j) *Emergency cut-out*

(i) Press the emergency cut-out button. The controls will free immediately and the indicator on the instrument panel will show white. If a fault occurs in the auto-pilot it will trip out automatically and the indicator on the instrument panel will show white.

(ii) If a fault occurs in the auto-pilot, causing it to run away, the auto-pilot will automatically be tripped as soon as the limit switches in the elevator or aileron circuits operate. If the fault is in the rudder circuit, the auto-pilot should be tripped by pressing the emergency cut-out button.

(k) *To re-engage after emergency cut-out*

After the auto-pilot has been tripped, either by pressing the emergency cut-out button or by the operation of the limit switches, it may be re-engaged by switching the controller switch to STAND-BY, pressing and releasing the pump re-set button, then, after one minute switching the controller switch to ON.

(l) *Prior to landing*

Switch the controller switch OFF, and then check that the controls are free. The controls feel heavy immediately after disengaging the auto-pilot, due to the "dashpot" effect of residual fluid in the servos. This is soon removed by making a few movements of the controls.

(m) *General notes*

(i) After completing a turn at bank angles below 10°, some slip and bank error will be evident when the auto-pilot is set for straight and level flight; this is due to the effect of a slight turn error in the horizon gyro and because the turn cut-out is not operative at small bank angles. This error will disappear after a short period of apparent straight and level flight.

(ii) Before shutting down or relighting either engine, the auto-pilot controller switch must be switched to STAND-BY. The aircraft must be re-trimmed before re-engaging the auto-pilot.

(iii) If excessively violent manoeuvres are made while the auto-pilot is engaged, the elevator or aileron trip switches may operate to trip out the auto-pilot. It may be re-engaged as detailed in sub-para. (k).

(iv) The horizon gyro fitted in conjunction with the auto-pilot incorporates a fast erection button which must be pressed to re-erect the gyro after toppling.

NOTE.—The artificial horizon fast erection button should not be operated while the auto-pilot is engaged.

(v) Reverse torque and operation of the feathering pump during feathering and relighting produces a slight kick on the controls when the auto-pilot is engaged.

Management of the wing fold system

(a) *Folding*

(i) Check that the flaps are fully housed, the control column is about central and unobstructed, and that the hydraulic pressure is at least 1,800 lb./sq. in.

(ii) Move the safety lever to FREE (outbo rd), then move the selector lever to SPREAD and hold it there for at least three seconds. Move the selector lever to FOLD, hold it there for one second and then set it to NEUTRAL. Check visually that all latch pins are withdrawn, if necessary repeating the *whole* of the above sequence.

NOTE.—If Mod. 247 is incorporated, (ii) above is not necessary.

(iii) Move the safety lever to FREE (outboard) then move the selector lever to FOLD. When the wings are fully folded leave the selector lever at FOLD and return the safety lever to SAFE.

NOTE.—If both main and emergency accumulators are fully charged the wings will fold without the engines running. If the pressure in the accumulators is below 1,800 lb./sq. in. it must first be built up with the handpump, before FOLD is selected, so that the outer latch pins will withdraw cleanly. Control locks may be in or out as desired. The ailerons and aileron tabs are automatically centralised when the wings are folded, and if the controls are unlocked the control column will centralise with considerable force as soon as the wing locking pins withdraw.

(b) *Spreading*

(i) Check flap lever is UP.

(ii) Move the safety lever to FREE.

(iii) Select SPREAD and check that the safety lever moves automatically to SAFE.

(iv) When the wings are fully spread, check the latch pin indicators and leave the selector lever at SPREAD for at least 5 seconds after the indicators show engaged.

(v) Check that all four indicator lights are out and test them to check that they are all serviceable.

(vi) Move the selector to NEUTRAL and check that the safety lever is at SAFE.

STARTING, TAXYING AND TAKE-OFF

79. **External checks**

The usual checks should be made for signs of damage, security of inspection doors, panels and filler caps. Static vent plugs must be removed. If the wings are folded, the wing fold actuating gear, together with the levers and switches which operate the wing pin warning system, should be checked for damage or distortion. In addition check:—

Hydraulic gauges (minimum air pressure) i.e. hydraulically fully discharged	*Main* 1,250 lb./sq. in. ±50 *Emergency* 1,250 lb./sq. in. ±50 *Wheel brakes* 1,550 lb./sq. in. ±50 *Hook buffer* 1,250 lb./sq. in. ±50
Oleo extensions	Main 2½ in. to 3½ in. depending on load Nose 1½ in. to 4 in. depending on c.g. position
Nosewheel doors	Closed, and external selector at closed
Bomb doors	Not in "Maintenance" position
Engine	Intake clear, covers removed
Cockpits	Jettison indicators in all cockpits safe, intercom. power on. Generator switches NORMAL. Radome switch HOUSED, guard in position. Both rear hoods properly locked. Pilot's hood open and handle turned to lock

80. **Internal checks**

Enter the cockpit and check:—

Parking brake	On. Check wheel brake pressure is substantially above 1,550 lb./sq. in. If it is below, see para. 23
Brakes	Check that progressive pressure on the pedals applies hydraulic

	pressure equally and smoothly. (Maximum per wheel 1,500 lb./sq. in.)
Footstep	Retracted (check with ground crew)
Armament jettison switch	Off. Guard on
Armament switches	Safe or off
R.A.T.O.G. MASTER switch	OFF
Circuit-breakers	Press in lid of box

Switch on the battery isolating switch. As this is done check the functioning, where possible, of the magnetic indicators.

NOTE.—To avoid relay chatter the battery isolating switch must be on when starting with an external supply connected.

If it is daylight, check that the night flying shades on all warning lights are turned to DAY.

Undercarriage	Down button in. Guard over UP button, 3 green lights, check bulbs change-over
L.P. cocks	Off
Wing fold selector lever	Corresponding to wings position (never at NEUTRAL, unless wings are spread and locked).
V.H.F.	Off, select channels.
Auto-pilot	OFF
Trimmers	Check operation and set as follows for take off:—
	Aileron—neutral
	Rudder—neutral
When loaded near the forward c.g. limit	Elevator:— 1 Div Nose down with flaps UP. Neutral with flaps at baulked landing position or fully down
When loaded near the aft c.g. limit	Elevator:— $1\frac{3}{4}$ Div Nose down with flaps UP. $\frac{3}{4}$ Div Nose down with flaps 30°–40°
Throttles	Hard back against the ground idling gates. (To ensure ignition)
H.P. cocks	Off (mid position)

J.P.T. control switches	NORMAL—WARNING ONLY on first engine to be started
Emergency flight fine pitch stop switches	NORMAL
Main hydraulic pressure gauge	Check reading. If less than 1,250 lb./sq. in. see para. 23
Oil cooler shutters	As required
Fire warning lights	Test
Fuel	Contents. Transfer indicators white
G.G.S.	Retracted
Bomb doors lever	Set to position of bomb doors
Emergency hydraulic selector lever	Off
Hook selector	UP. Check hook light by operating DECK TRAINING switch (if fitted).
Hood jettison lever	In
Oxygen	Contents, delivery
Starting fuel pump master switch	ON
Cockpit ventilation and heating	As required
Starter pushbuttons	Fully up. Guard switch OFF
Internal and external lighting	As required (check emergency lighting)
Control surfaces and throttle locking levers	As required
Harness and headrest	Adjusted

81. **Starting the first engine (cartridge)**

(a) If the engine is hot or the aircraft is facing a strong wind, a single cartridge may accelerate the engine to 4,000 r.p.m. or above, in which case it should pull away without further assistance. However, single cartridge starts are the exception and the pilot should normally be prepared to make a two-cartridge start.

L.P. cocks	Both ON. Check aurally that the booster pump and main inverter start up and that the recuperator, FLIGHT

	INSTRUMENTS, and NORMAL INVERTER FAILURE indicators show black. If, due to low voltage or a momentary electrical overload, the NORMAL INVERTER FAILURE indicator shows white, reset the NORMAL inverter immediately after start up by pressing the changeover and test button
Unfeathering	If the oil temperature is below 10°C. use an external battery for the first engine. With the H.P. cock of the first engine to be started in the OFF (mid) position press the relight button to fine off the propeller to the 6° position
J.P.T. control switch	WARNING ONLY
Starting fuel pump master switch	ON (forward)
Throttles	Closed to Ground Idle

(b) Open the appropriate H.P. cock, move the starter guard switch to expose the appropriate button, and press the latter firmly to commence the starting cycle. Check that the ignition light comes on. After a 2 seconds delay, during which time the starting pump and ignition can be heard to function, the cartridge fires and should accelerate the engine to 4,500 r.p.m. within about 4 seconds. Light-up occurs between 1,500 and 2,000 r.p.m. and the engine should continue to accelerate steadily beyond 4,500 r.p.m. until ground idling speed is reached. Check J.P.T. and oil pressure. The starter guard-switch must not be returned to OFF until the starter button has reset. Under tropical conditions, if the J.P.T. stabilise above the limit at ground idling, open the throttle slightly to bring the J.P.T. within the normal operating limits.

(c) *If the engine fails to attain self-sustaining r.p.m.* of 4,400–4,500 on a single cartridge, the H.P. cock should be moved to OFF *before* the J.P.T. rises significantly. When the r.p.m. have fallen to 1,200 put the H.P. cock ON and immediately press the starter button to fire a

further cartridge. The r.p.m. will have fallen to about 1,000 before the cartridge fires, but this is quite sufficient. If the second cartridge is fired at r.p.m. above this, the starter overspeed protective device will be caused to operate with excessive frequency. This will cause wear which may affect its functioning under emergency no-load conditions (i.e. transmission failure, etc.) and, in an extreme case, can lead to violent disintegration of the starter.

NOTE.—A close watch must be kept on the J.P.T. and if at any time it reaches 700° C. (the bell and warning light will operate), close the H.P. cock to the OFF (mid) position.

(d) If a cartridge fails to fire after about 4 seconds, immediately return the H.P. cock to OFF to prevent the starting fuel pump overfuelling the engine. Re-check the throttles fully closed. Carry out the procedure in para. 86. If the remaining cartridge is unlikely to suffice for a further start, switch off electric power and after waiting one minute reload the starter.

(e) If the engine fails to light up, return the H.P. cock to OFF. Check that the propeller is at the 6° position and carry out the procedure in para. 86.

82. **Checks after starting the first engine**

(a) Immediately an engine has started, check the J.P.T. and oil pressure. The oil pressure gauges are sluggish in operation and it may be several seconds before they indicate oil pressure on a start-up. If they do not start to indicate about 7 seconds after the engine has started to turn, the start should be abandoned and the cause investigated.

(b) Warm up with the throttle at the flight idle gate. Oil cooler shutters should normally be closed to assist the warm up. Maximum S.H.P. while warming up is 800 but this may be exceeded for windmill starting provided that oil temperature is in excess of 5° C. However the engine must be throttled back to a maximum of 800 S.H.P. as soon as possible after the windmill start is completed.

(c) Fire warning lights Out
J.P.T. control switch NORMAL

Hydraulic and brake pressures	Increasing to maximum of 2,600 lb./sq. in. Pre-Mod. 409 or 455, turn emergency cock 90° clockwise, check gauge (15) needle moves, return cock to normal position. Post-Mod. 409 or 455, check emergency accumulator indicator black.
Generator warning lights	Out

83. **Starting the second engine (windmill starting from the feathered position)**

(a) Check:—

J.P.T. control switch	NORMAL
Throttle	Closed to ground idle

(b) Confirm that the brake pressure is building up. Open up the running engine to full power, observing the normal precautions. If the oil in the P.C.U. is cold (minimum permissible oil temperature for opening up for a windmill start is + 5° C.), open up very slowly to prevent overspeeding, until constant speeding r.p.m. of 15,000 are reached. Beyond this, increase power smoothly to the take-off position, checking the J.P.T., S.H.P. and constant speeding r.p.m.

(c) Move the H.P. cock of the second engine to ON to release the propeller brake, then return it to OFF. Press the relight button until r.p.m. are 1,500, move the H.P. cock to ON, release the button and check that the ignition light stays on. If ignition ceases before the engine lights up, press the relight button again. When the r.p.m. reach 9,000 throttle the first engine to FLIGHT IDLE and then open up the second engine slowly to FLIGHT IDLE.

(d) If the J.P.T. is likely to exceed 700°, return the H.P. cock to the FEATHER AND BRAKE position. Windmill the engine with the H.P. cock in this position for about 15 seconds or until it is almost feathered, whichever takes less time. Repeat the windmill start procedure, but see para. 86.

NOTE.—Running an engine at take-off power on the ground should be kept to a minimum.

84. **Checks after starting the second engine**

As in paragraph 82 plus:—

Radio and Intercom.	On. Check crew call
Mk. 4B compass	Check main inverter is running. If wings are spread synchronise and check standby compass
Auto-pilot	Check functioning then OFF
Flaps	Check operation and leave up
Bomb doors	Check operation and leave closed

85. **Compressed air starting (Port engine only)**

(a) Have the airline (1,200 lb./sq. in.) securely connected.

(b) Carry out the starting checks in para. 81 as far as:—
Throttles Closed to Ground Idle

(c) Open the H.P. cock, signal for compressed air, and press the relight button to commence the starting cycle. Check ignition light on.

(d) At 4,500 r.p.m. signal for the air supply to be cut off. The engine should continue to accelerate to idling r.p.m. The starter must not be used to turn the engine above 4,500 r.p.m. and it is important, therefore, that the compressed air is cut off as soon as the engine reaches this speed.

(e) If there is no light up after 7 seconds close the H.P. cock to the OFF (mid) position to avoid overfuelling. Motor the engine over on the starter for a few seconds to dry it out, taking care not to exceed 4,500 r.p.m. Return the H.P. cock to ON, press the relight button and check the ignition light comes on. If a second attempt is unsuccessful, the start must be abandoned and the fault investigated.

NOTE.—The starter must not be allowed to operate for more than 20 seconds.

86. **Action following a "wet" or "hot" start (Ground only)**

If the engine fails to light up, or a cartridge has misfired, or a start has been abandoned owing to overheating, the automatic control of the starting pump should be over-

ridden by turning the starter fuel pump master switch OFF to avoid overfuelling and consequent overheating. If two attempts to start prove unsuccessful, the fault should be investigated before a further attempt is made.

87. **Engine idling R.P.M. checks**

After a major inspection, or at the pilot's discretion:—
When the oil inlet temperature has reached 50 to 60° C. and with a head-wind component of not more than 10 knots check:—

	R.P.M. both engines	Max. J.P.T.	Min. oil pressure
Both engines at ground idle	9,400 ± 200	520	25
Both engines at flight idle	14,300 ± 100		

NOTE.—1. The ground idle and flight idle gate settings must be within the above limits. When assessing the basic r.p.m. obtained at these throttle settings, it is necessary to conform to the following standards:—

Oil temperature between 50 and 60° C.
Aircraft across wind of not more than ten knots.
The throttles should be moved above the setting desired, and then closed on to it.

2. J.P.T. and S.H.P. vary with ambient air temperature. Consequently, if the air temperature is appreciably above I.C.A.O. with the control spilling fuel to maintain the correct J.P.T. *a reduction of about 13 S.H.P. per 1° C. above ICAO is to be expected.*

3. The S.H.P. and oil pressure gauges are sluggish in operation and may give false readings for a few seconds following a change in engine power or r.p.m.

4. Power checks up to take-off power with wings folded are permitted on one engine at a time.

88. **Taxying**

(a) Check that the application of equal toe pressure applies reasonably equal and smooth braking effect on each wheel.

(b) Idling thrust on two engines is fairly high, and once the aircraft is moving it is generally possible to taxy with the throttles in the ground idle position. In order to save wear and tear taxy on one engine where practicable.

(c) The greatest care must be taken when taxying in confined spaces. The brakes are powerful and it is difficult to apply them smoothly and equally.

(d) When taxying over long distances, particularly in strong winds, it is recommended that the aircraft be stopped periodically to allow the brakes to cool.

(e) Taxying with wings folded and with wing stores is permitted over smooth surfaces at walking speeds only.

(f) *Use of the brakes.* The parking brake must never be operated when the aircraft is moving except in dire emergency. If the toe brakes fail due to lack of pressure, so will the parking brake. In emergency, or where the brake accumulator is empty (1,550 lb./sq. in. or less) brake pressure can be temporarily applied (provided no other service has been selected) by first pressing the toe pedals and then operating the handpump.

(g) The emergency hydraulic accumulator will not operate the brakes.

89. **Checks before take-off**

Elevator trimmer	*Forward C.G.* Flaps up—1 div nose down Flaps at 20°–40°—neutral *Aft C.G.* Flaps up—1¾ div nose down Flaps at 20°–40°—¾ div nose down
Aileron and rudder trimmers	Neutral
Auto-pilot	OFF
Fuel	H.P. and L.P. cocks fully on Starting fuel pump master switch on Contents Wing tank transfer indicators black

Flaps	Select as required. Where possible check tailplane incidence is functioning
Bomb doors	Closed—indicator black
Radome	Indicator black Emergency selector switch housed
Wings	Spread Selector lever locked at NEUTRAL. Mechanical indicators flush, all indicator lights out. Press switch to check circuit (Pre.-Mod. 33, check indicators black)
Instruments	Oil temperature minimum 25°C. Check P.C.U.s by increasing to 15,000 R.P.M. Oil pressures Artificial horizon erect Turn and slip indicator satisfactory Pressure head heater on Main inverter operating. Flight instruments indicator black Check Mk. 4B compass with E.2 compass
Oil cooler shutters	As required
Oxygen	As required
Hydraulics	Main and brake pressures normal. Emergency accumulator indicator black (Post-Mod. 409 or 455)
Hoods (Rear)	As required (Closed before 130 knots)
Hood (Front)	As required (Closed before 175 knots)
Harness	Tight and locked
Controls	Unlocked. Full and free movement

90. **Take-off**

NOTE.—1. "Safety speed" is defined as the minimum speed at which the aircraft can be climbed away on one engine at full power, the dead engine auto-feathered (i.e. nearly feathered), and with the undercarriage and full flap going up in accordance with the recommendations in

sub-paragraph (d) below. At an A.U.W. of 19,600 lb. with no external stores, with a full throttle indicated S.H.P. of not less than 1,150, bomb doors closed and radome housed, this speed is 110 knots.

2. Maximum Shaft Horse Power obtainable is reduced as altitude and ambient air temperature increase. *The auto j.p.t. control may reduce take-off power by as much as 240 S.H.P. per engine* in very high temperature conditions. If less than 1,150 S.H.P. is obtainable, due to one of the above variables, the safety speed may be increased by up to 15 knots, depending on the reduction in S.H.P.

3. Minimum take-off run is achieved by using full flap, but as a compromise between this and securing an adequate single engine performance in case of engine failure, it is recommended that baulked landing flap (20°) is used on airfields.

(a) Taxy forward a few yards to straighten the nosewheel, and *when the aircraft is at a standstill*, apply the parking brake. Open up to take-off power, check that the horse power developed is normal for the ambient air temperature conditions and then release the parking brake.

(b) There is little indication how far the nosewheel is clear of the ground on the take-off-run, and the elevators should be used with care, particularly in a flaps-up take-off, to avoid unnecessary drag due to excessive incidence. Approximate minimum unstick speeds at 19,600 lb. A.U.W. are 70 knots flaps down, and 80 knots flaps up. On normal runway take-offs, the aircraft should be flown off at speeds ten knots above these figures.

(c) Though rudder control is good, there is considerable "crabbing" on crosswind take-offs and, to increase tyre adhesion in the early part of the take-off-run, it is recommended that the nose is not allowed to lift until just before the take-off speed is reached.

(d) Once airborne, brake the wheels and retract the undercarriage. As soon as the undercarriage is up or almost

up, the flaps may be raised in 2 stages, or "inched" up as required. There is a moderate nose-down trim change as the flaps go up.

(e) Maximum power is not necessary for the climb and maximum continuous power should be used. This normally gives an adequate climb performance.

91. **Catapult take-off**

(a) The following additional checks should be made prior to a catapult launch:—

Trim	*Forward c.g. limit*—all neutral. *Aft c.g. limit*—three quarter div. nose down
Flaps	Fully down (40°)
Head rests	Adjust and lock
Recuperator indicators	Both black

(b) During the launch, the stick should be held 2 inches aft of the "locked" position.

HANDLING IN FLIGHT

92. **Climbing**

(a) The recommended climbing speeds in knots at all loadings, without external stores, are as follows:—

2 engines	From sea level to 5,000 ft.—140 knots reducing to 135 knots at 5,000 ft.
1 engine (under normal temperature conditions)	From sea level to 5,000 ft.—125 knots reducing to 120 knots at 5,000 ft.

If bulky external stores are carried these speeds may be reduced by 5 knots.

(b) *Normal climb*

Climb at maximum continuous power (i.e. 540°C. J.P.T.).

(c) *Operational climb*

Climb at take-off power for 10 minutes and then throttle back to maximum continuous power.

93. **Cruising**

The aircraft can be cruised at any power setting in the 15,000 r.p.m. range, the limiting factor being a J.P.T. of 540°C.

94. General flying

(a) The aircraft is easy and pleasant to fly, and the flying controls are well harmonised in all normal flight conditions. At high speeds the harsh use of aileron must be avoided.

(b) *Trimmers*

The trimming controls are very effective within the normal speed range, but maximum rudder trim may have to be supplemented by some foot force on a single engine landing or overshoot. The electrical aileron trimmer is very powerful. Should it lock fully over due to a fault in the actuating gear, the wings can be held level only up to a maximum indicated airspeed of 225 knots.

(c) With an asymmetric load of up to 8 x 60 lb. rockets on one side, lateral control is quite adequate at all speeds down to the stall.

95. Changes of trim

(a) *Longitudinal trim*

Lowering flaps	
to 20°	Moderate nose up
to fully down (40°)	Moderate nose up
With increase in power	Slight nose up. (Strong nose up when recovering from an all down stall)

(b) *Lateral trim*

Lateral trim changes in flight are negligible. If one mid-wing tank is full, and the other empty, this corresponds to one division of the aileron trimmer indicator only.

(c) *Directional trim*

There are no directional trim changes with speed or throttle setting when flying with both engines at equal power. With one engine feathered, directional trim should be adjusted by use of the trimmer in the normal way.

(d) There is little change of longitudinal and lateral trim when operating the undercarriage, radome and bomb doors, but there may be some momentary directional trim changes. With the radome lowered, there may be some snaking at speeds above about 180 knots.

96. **Flying at reduced airspeed or in poor visibility**

(i) Reduce speed to 130 knots, lower the flaps 20° and reduce the speed further to 110 knots.

(ii) *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 to the aircraft may suffice to assist the first movement of the blade.

97. **Flying in conditions of severe turbulence**

The recommended speed is 135 knots.

98. **Stalling**

NOTE.—1. When the flight fine pitch stops are withdrawn (i.e. undercarriage down) and the throttles are at Flight Idle, there is a marked deterioration of elevator power at speeds near the stall. With power on, the elevator retains full effectiveness.

2. With approach power or less and the flight fine pitch stops engaged (i.e. undercarriage up) engine R.P.M. will decrease as the stall is approached but elevator effectiveness is retained. The reduction in R.P.M. will be governed by the power selected, and with throttles at Flight Idle the R.P.M. may fall to 13,000. At these R.P.M. the throttles should not be opened rapidly on recovery from the stall.

3. External stores, or one propeller feathered have little effect on stalling speeds.

(a) The approximate stalling speeds in knots are as follows:—

	19,000 lb.	21,000 lb.
Flight Idle power		
Flaps and Undercarriage up	90 to 95	95 to 100
Flaps and Undercarriage down ..	75 to 80	80 to 85
Approach power		
Flaps and Undercarriage up	85 to 90	90 to 95
Flaps and Undercarriage down ..	70 to 75	75 to 80

(b) There may be a slight elevator buffet just before the stall with flaps up, but this should not be relied on as a stall warning. There is no warning of the stall with flaps down.

(c) *Engine off*

The stall, undercarriage up or down, with both throttles at the flight idle gate, is mild and occurs with a gentle nose drop against full up elevator, together with slight lateral unsteadiness. When recovering from stalls with the flight fine pitch stops withdrawn, i.e. undercarriage down, the elevator is not immediately effective in recovery from the ensuing dive unless engine power is used. The elevator effectiveness returns sharply, thus application of power should be gentle and the control column eased forward as power is applied, otherwise a further stall may occur.

(d) *Engine on*

The engine-on stall occurs as in sub. paragraph (c) above, but the elevator retains its effectiveness throughout. There may be some slight aileron buffet just before the stall, but the ailerons retain their effectiveness up to and during the stall.

99. **Diving**

The elevator control forces should be trimmed out during the dive, otherwise excessive G may result during recovery.

CIRCUIT PROCEDURE AND LANDING

100. **Checks before landing**

Bomb doors	Closed
Radome	Housed
Auto-pilot	OFF
Propellers	Flight fine pitch stops NORMAL
Undercarriage	Down and locked
Brakes	Sufficient pressure
Arrester hook	As required. Green light as appropriate
Flaps	Fully down on final approach (20° if on a single-engine landing)
Fuel	Contents
Harness	Tight
Hood(s)	Locked as required

101. **Approach and landing**

(a) With the undercarriage down and flaps at 20° the turn on to the final approach should be made at about 110 knots and full flap selected. Cross the airfield boundary at 90 to 95 knots, closing throttles to the flight idle gate when on the runway. Close the throttles to the ground idle gate only when the aircraft is on the ground and when it is not intended to take off again.

(b) There will be a nose-down trim change and a large reduction in lift when power is reduced to the flight idle gate, and this is particularly marked if the airspeed is below about 100 knots and the throttles have been moved quickly through an appreciable amount. The throttles should not therefore be fully closed at speeds below 100 knots on the approach, and gentle throttle movements should always be made in order to achieve a steady angle of approach.

(c) *Deck-landing*

The recommended speed for a deck-landing is 85 to 90 knots, depending on the weight. The throttles must be kept appreciably above the flight idle gate during the approach. If they are closed rapidly, loss of height will result.

(d) *Power settings*

There is no immediate impression of an increase or decrease in power as the throttles are moved and reference should be made to the S.H.P. indicators, bearing in mind that these are sluggish in operation. At 17,900 lb. A.U.W. a total of about 800 S.H.P. is normally required on the final approach for an airfield and deck-landing, all down.

(e) After the throttles are closed to the ground idle gate, deceleration is good. It is difficult to apply equal braking on both wheels, and this may lead to small deviations from a straight landing run if the brakes have to be used. Full brake application will lock the wheels at the higher speeds.

102. **Overshooting and roller landings**

(a) When carrying out roller landings the throttles must not be closed beyond the flight idle gate.

(b) On going round again from the approach, open the throttles fully. Raise the undercarriage, retrim and raise the flaps in stages.

(c) Should it be essential, for reasons of safety, to go round again after touch-down when the throttles have been closed to the ground idle position, they must be moved very slowly until constant speeding r.p.m. of 15,000 are attained. Normal throttle movements can then be made.

103. **Instrument approach**

The following table gives the approximate speeds, power and flap settings for use during instrument approaches with the undercarriage down.

	Total S.H.P.	Flaps	Airspeed
Pattern	1,000	Up	130
Final	1,000	20°	110
Glide Path .. .. (10 knot wind)	600	20°	95

104. **Flapless landings**

The approach is flatter than normal and speed should be maintained at 115 knots while manœuvring, reducing to 105 knots over the hedge. A *total* power of approximately 500 S.H.P. will be required to maintain the glide path.

105. **Checks after landing**

Brake pressure	Sufficient for taxying
Flaps	Up (flaps *must* be fully up before selecting wings folded)
Oil	Temperature
J.P.T.	Normal
Idling R.P.M.	Normal
Pressure head heater	OFF

106. **Stopping the engines**

(a) Move the H.P. cock levers to FEATHER AND BRAKE. If it is necessary to apply the propeller brakes, press the relight button *after* the engine has slowed down to about 3,000 r.p.m., keeping it pressed until the propeller has stopped.

(b) The L.P. cocks may be turned off *after* the H.P. cocks have been closed, without waiting for the propellers to stop.

(c) Switch off all electrical services.

SINGLE ENGINE FLYING

107. **Stopping an engine in flight**

(a) Close the oil cooler shutters, preferably some time before the engine is stopped, so as to raise the oil temperature.

(b) Close the throttle to the flight idle gate.

(c) Move the H.P. cock lever to FEATHER AND BRAKE.

(d) Close the throttle to the ground idle gate in preparation for relighting.

(e) Press the relight button when r.p.m. drop below 3,000. When the propeller is fully feathered release the button.

(f) Leave the L.P. cock on.

NOTE.—Due to a safety interlock the H.P. cock cannot be closed with the throttle opened to more than approximately 1 inch forward of the flight idle gate.

108. **Single engine flight**

(a) When an engine has been stopped for some time, the oil in the P.C.U. will cool before that of the engine, and the oil temperature gauge will therefore give a misleading reading. Restarting in the air should normally be undertaken before the oil temperature gauge shows less than + 20° C., or in any case at half hour intervals. This will equalise wear in each engine, and maintain oil temperature.

(b) The single engine performance below 5,000 ft. is good and should be utilised where practicable when flying for range or endurance at low altitude. (With one engine at climb power at an A.U.W. of 19,000 lb., altitudes in excess of 7,000 ft. can be attained.) The maximum aircraft weight at which single engine

flying can be undertaken reduces with increase in ambient air temperature. The following table gives a considered estimate of the maximum weight for single engine operational flying at 2,000 ft., at the recommended minimum comfortable speed under various temperature conditions with the aircraft in the clean condition.

Air temp. °C. at 2,000 ft.	Radome up		Radome down	
	Max. wt. (lb.)	I.A.S.	Max. wt. (lb.)	I.A.S.
11° (I.C.A.O.) ..	21,600	145	21,600	138
21°	21,600	145	20,900	135
31°	19,500	138	18,900	129
41°	17,900	132	16,900	122

109. **Relighting an engine in flight**

Check the following:—

(a) The throttle is *fully* closed to the ground idle position.

(b) The flight fine pitch stop switch is at NORMAL (but see NOTE (2) below) and the auto j.p.t. control switch is at NORMAL.

(c) The starting fuel pump master switch is ON.

(d) Move the H.P. cock ON and press the relight button. Release it when the r.p.m. reach 2,500 to 3,000. Check ignition warning light, j.p.t. and oil pressure.

(e) The build-up of r.p.m. is rapid and the throttle should be opened steadily to the flight idle gate when the r.p.m. reach approximately 8,000. Reverse torque action will then prevent the r.p.m. from increasing too quickly. When the engine is running smoothly at constant speeding r.p.m. open the throttle to the desired setting.

NOTE.—1. If the engine fails to relight, put the H.P. cock lever to FEATHER AND BRAKE before repeating the relight cycle.

2. No attempt must be made to relight an engine in flight with the undercarriage down (i.e. F.F.P. stop withdrawn), as propeller drag may cause considerable loss in height. If in emergency, a relight becomes necessary with the undercarriage down, the F.F.P. stop switch must first be set to engage before a relight is undertaken.

110. **Single engine landing and overshoot**

(a) Carry out a normal approach, but with flaps at not more than 20°, and at an airspeed of 100 knots to the threshold.

(b) *Going round again on one engine*

The aircraft will go round again on one engine, at speeds of 100 knots and above, at A.U.W.s up to 19,600 lb., *with no external stores*, provided the undercarriage is selected up and full power is applied at a height of not less than 100 feet, above the ground. If the height or airspeed is lower than this, *or if the power on one engine is limited by the j.p.t. control*, i.e. less than 1,200 S.H.P., it will not always be possible to climb away.

(c) The initial climb away, with the undercarriage going up, and flaps at 20°, should be made at 100 knots. *The speed should not be allowed to fall below this, as the drag will increase.* If the aircraft will not climb at 100 knots, it will not climb at speeds less than this. When the undercarriage is up or nearly up, inch the flaps up a few degrees at a time, allowing the airspeed to rise by 15 knots as this is done. Continue the climb at 120 to 125 knots.

NOTE.—Before making a single engine deck landing, it is particularly important that the A.U.W. be reduced to the minimum below 17,900 lb. *and that no external stores are carried.* This

will ensure an adequate single engined performance.

111. **Single engine take-off**

(a) In certain circumstances it may be operationally essential to take off with one engine inoperative. Whereas this presents no problems if the correct conditions are fulfilled and exactly the correct drill is carried out, pilot error can easily make the length of the take-off run prohibitive.
The following conditions are mandatory:—

(i) The runway must be a minimum of 2,000 yards hard and level.

(ii) Maximum A.U.W. is 16,750 lb.

(iii) A minimum of 1,200 S.H.P. must be available.

(iv) The temperature must be low enough so that the j.p.t. control does not spill.

(v) Flaps must be fully housed.

(vi) The dead engine must be fully feathered and the propeller brake applied.

(vii) 10 knots of natural head-wind must be available.

(b) Carry out the normal pre take-off checks for one engine but apply full port rudder trim if the port engine is to be used and vice versa. Check flaps are fully housed. Line the aircraft up and ensure that the nosewheel is straight. Apply the parking brake and open up the live engine fully. Allow the S.H.P. to stabilise and ensure that the engine is producing a minimum of 1,200 S.H.P.

(c) Apply full appropriate rudder and release the parking brake. Acceleration will be slow and the use of the toe brakes must be kept to an absolute minimum. If more than two slight applications of brake are required the take-off run will be increased to prohibitive lengths for a normal runway, and the take-off must be abandoned. Hold the nosewheel on the ground until the A.S.I. indicates 95 knots, then gently raise the nosewheel until the aircraft becomes airborne at 100 knots. Continue the initial climb at 100 knots.

(d) Under no circumstances must take-off flap be used, neither must the nosewheel be lifted off the runway before 95 knots otherwise the drag rise will be such that the aircraft will not accelerate.

PART IV

EMERGENCY HANDLING

112. **Engine failure on take-off**

(a) Reverse torque action will automatically start to feather the propeller.

(b) Close the throttle to the flight idle gate, and close the H.P. cock to the FEATHER AND BRAKE position; complete the feathering operation by pressing the relight button.

(c) Raise the undercarriage.

(d) If the flaps are being used for take-off they must be inched up *gradually without waiting for the undercarriage to lock up.*

(e) With flaps and undercarriage going up, climb away initially at 100 knots allowing the speed to increase to 115 to 130 knots by the time the flaps are fully up.

113. **Engine failure in flight**

(a) Close the throttle to Flight Idle.

(b) Reverse torque will start to feather the propeller automatically. Close the H.P. cock to FEATHER AND BRAKE and press the relight button to feather the propeller fully.

(c) In the case of suspected mechanical failure in the engine, the engine must be stopped, after closing the throttle to Flight Idle, by moving the H.P. cock to

FEATHER AND BRAKE and pressing the relight button.

(d) *Total engine failure*

Should the engine fail while flying on one engine, if there is likely to be any delay before a relight is made on the other one, ensure that full electrical power is made available for the ignition and the feathering pump motor by switching off all non-essential electrical services. Follow the same drill as for normal relighting. Without slipstream aid the unfeathering propeller will take about 4 seconds longer to spin up the engine. At 125 knots, starting up in these circumstances will cost approximately 15 knots or 150 feet.

114. **P.C.U. failure in flight**

(a) It may be difficult to diagnose a P.C.U. failure in flight, as the symptoms may be similar to those of fuel starvation, but a failure should be suspected if reverse torque occurs together with engine surge and lack of power on one engine.

(b) *Immediately set the flight fine pitch stop of the faulty engine to ENGAGE.*

NOTE.—This action will not necessarily ensure that the minimum pitch in the air is 21°, unless it is done when the propeller is at 21° or a coarser angle. Thus, to minimise the danger of the propeller going to the 6° position, it is important that the stop should be engaged *immediately* any signs of P.C.U. failure are apparent.

(c) If possible, stop the engine and continue the flight on the other.

(d) If it is not possible to stop the propeller turning due to a fault in the feathering circuit, the windmilling drag on that engine may reduce the single engine performance considerably, such that a loss in height occurs. It may therefore be better to restart it immediately in the following manner:—

(i) With the H.P. cock OFF, adjust the airspeed so that the windmilling r.p.m. of the dead engine are as low as possible (approximately 10,000). This will correspond to an airspeed of about 120 knots if the propeller is at 21°. The chances of a relight are increased in these circumstances with reduction in windmilling r.p.m. and when the engine is still warm.

(ii) Make the relevant checks for a normal start, move the H.P. cock ON and press the relight button. When a relight has occurred maintain a constant airspeed of about 130 knots and carefully open the throttle to a point where the S.H.P. is 350 to 400. If the throttle is opened beyond this point, or if the airspeed is allowed to rise, the engine may tend to overspeed, and the overspeed governor may operate and partially cut off the fuel supply to the engine and thus cause surging.

NOTE.—Due to possible loss of oil, keep a check on the oil pressure of the faulty engine. If this shows signs of dropping below 40 lb./sq. in. power should be cut off as there may be danger of engine seizure.

(e) Make a normal approach, using the good engine for adjustments in speed and height, throttling back the faulty engine only on touchdown.

(f) After touchdown, close the H.P. cock of the faulty engine.

115. **Landing with the undercarriage up**

(a) Make a normal approach and landing, bearing in mind that drag on throttling back will be less than usual and there will be an increase in elevator effectiveness due to the engagement of the flight fine pitch stops.

(b) Throttle-open movements on the approach must be made slowly.

(c) Close the H.P. cocks on touchdown.

NOTE.—It is possible that less damage to the engines will result if the approach is made using one

engine, the other being fully feathered and the propeller moved to the X position. This alternative method may be used at the pilot's discretion.

116. **Landing with the flight fine pitch stop engaged**

(a) If, due to an electrical failure or following a manual selection, the flight fine pitch stops are engaged, make a normal approach and landing, bearing in mind that there will be an increase in elevator effectiveness and less drag on throttling back.

(b) Throttle-open movements on the approach must be made slowly.

(c) After touchdown, close the H.P. cock of the engine which has the F.F.P. stop engaged.

117. **Emergency use of the auto j.p.t. control over-ride switches**

(a) Except for cartridge starting, the switches should always be left at NORMAL. Their primary function is to isolate the auto j.p.t. control systems should they become faulty. There may be a slight engine surge when moving the throttle in conditions when the system is functioning. This should die out after a few seconds. If it persists, the system should be isolated. J.P.T. must then be kept within the limit by adjusting the throttle.

(b) If the j.p.t. limit is exceeded at any time, this must be noted in Form 700.

118. **Engine stalling**

(a) If an engine has stalled, this will be denoted by a rumbling noise followed by a rapid rise in j.p.t. with the warning bell and light indicating, and complete loss of power of that engine. *The throttle must be closed to the flight idle gate immediately* and must not be opened until the j.p.t. returns to normal. The reverse torque indicator may blink on and off during the time an engine is stalled. If, on re-opening the throttle,

there is a rise in j.p.t. without a corresponding increase in S.H.P., the engine is probably still in a stalled condition. It must therefore be stopped immediately and relit.

(b) If doubt exists which engine has stalled, close both throttles. It is essential that the throttle of the stalled engine is closed within a few seconds of the stalled condition occurring, otherwise severe engine damage will result.

NOTE.—If at the time of an engine stall the airspeed is below 100 knots and the flight fine pitch stop is withdrawn (i.e. in the landing configuration), it may not be expedient to close *both* throttles at low altitude, owing to the large loss in lift and nose-down trim change which occurs.

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

(a) Stop the engine, if possible, by closing the throttle, selecting the H.P. cock to FEATHER AND BRAKE, and pressing the relight button.

(b) Put the *appropriate* L.P. cock OFF.

(c) If possible, reduce speed to a safe minimum and, preferably before *completing* the feathering operation, press the appropriate fire-extinguisher button.

(d) If the fire warning light continues to show, press the engine bay fire-extinguisher button.

120. **Failure of the hydraulic system**

(a) *Pre-Mod. 409 or 455*

(i) A failure of the engine-driven hydraulic pump will be indicated by the main accumulator pressure falling below the "cut-in" pressure of 2,100 lb./sq. in. Loss of hydraulic fluid due to a leaking pipe-line will have the same effect, but if the leak is on the "service" side of a selector, it may not become apparent until that service is selected.

(ii) Until the emergency accumulator is brought into circuit, there will be no indication of what pressure remains in it, but a fault in the line from it is less likely than a fault in the main circuit. If the drop in main pressure below 2,100 lb./sq. in. is slow, the emergency accumulator may be selected momentarily to check the pressure in it. If emergency pressure is high the accumulator may be conserved for lowering the undercarriage and hook (if required) before landing, but if the pressure is low the undercarriage and hook (if required) should be lowered as soon as possible while pressure is still available.

(iii) In the event of any fault in the system as above, select hook down (if required). If Mod. 238 is not fitted the hook may come up of its own accord when pressure in the emergency system is all used. It should be checked prior to touchdown. Bring the emergency hydraulic accumulator into circuit by turning the handle 90° clockwise. Before selecting the undercarriage down, check that the main hydraulic pressure gauge shows at least 2,000 lb./sq. in. If it does not, pressure should be built up to at least this figure with the handpump. The undercarriage should then be selected down. If the undercarriage will not lower when selected, pressure is too low and the undercarriage should be selected up again and the pressure built up with the handpump before making a further attempt to select it down. When the undercarriage is down and locked, select flaps as required.

NOTE.—1. Emergency hydraulic accumulator pressure is not available for the brakes, nor will it operate the pilot's hood unless Mod. 276 is fitted, but providing the hydraulic circuit is intact, the handpump may be used (see paragraph 23).

2. If the flaps are lowered by the handpump, the tailplane will not follow in synchronisation unless a pressure of at least 1,800 lb./sq. in. is first built up in the accumulator before flap is selected.

3. If the flaps are lowered by the handpump with insufficient pressure to move the tailplane incidence gear, i.e. below 1,800 lb./sq. in. and the emergency accumulator pressure is subsequently selected, the tailplane may rapidly change incidence with a consequent sharp nose-up trim change.

4. Failure of the tail incidence actuator will be indicated by excessive longitudinal stick forces developing after a flap selection. Should this happen, there is still adequate trim available for a normal "no-cut" landing to be made. If the actuator has failed, raising the flaps produces a strong nose-up change of trim, and vice versa.

(b) *Post-Mod. 409 or 455*

(i) A failure of the engine-driven hydraulic pump will be indicated by the main accumulator pressure falling below the "cut-in" pressure of 2,100 lb./sq. in. Loss of hydraulic fluid due to a leaking pipe-line will have the same effect, but if the leak is on the "service" side of a selector, it may not become apparent until that service is selected.

(ii) It is most unlikely that a fault can occur in the emergency circuit without the main circuit being affected; if, therefore, the emergency accumulator magnetic indicator goes white, immediately check the main pressure gauge. If the main pressure is normal, a failure of the magnetic indicator is probable. If pressure is low, immediately lower the undercarriage and hook (if required) while some pressure is still available. If at any time in flight the main pressure drops below 2,100 lb./sq. in., a careful watch must be kept on the emergency magnetic indicator and if it goes white the undercarriage should be lowered immediately.

(iii) In the event of any fault in the system as above, check that the hook is *selected up*, then select the emergency accumulator and immediately select

the undercarriage down. When the undercarriage is down and locked an attempt may be made to operate other services using any pressure left in the main accumulator and also using the handpump.

NOTE.—1. A minimum of 2,000 lb./sq. in. is required to lower the undercarriage. If the undercarriage will not lower when selected, pressure is too low and the undercarriage should be selected up again and pressure built up with the handpump before making a further attempt to select it down.

2. The hook should be *selected up* while the undercarriage is lowered by the emergency system. The return from the undercarriage jacks will then pressurise the hook buffer, even if the hook has dropped due to lack of main hydraulic pressure.

3. If the flaps are lowered by the handpump, the tailplane will not follow in synchronisation unless a pressure of at least 1,800 lb./sq. in. is first built up in the accumulator before flap is selected. Failure of the tail incidence actuator will be indicated by excessive longitudinal stick forces developing after a flap selection. Should this happen, there is still adequate trim available for a normal "no-cut" landing to be made. If the actuator has failed, raising the flaps produces a strong nose-up change of trim and vice versa.

121. **Action in the event of electrical failure**

(a) Should any electrical service fail, the first action should be to press in the lid of the circuit-breaker box to re-set any circuit-breakers which may have tripped.

(b) *Main inverter failure*

Main inverter failure is indicated by the magnetic indicator beside the test change-over button showing

white. The flight instruments magnetic indicator should remain black indicating that the stand-by inverter has automatically taken over. Pressing the test change-over button for 2 seconds and then releasing it will often cut in the main inverter once more. The only other action possible is to press in the lid of the circuit-breaker box.

NOTE.—When the stand-by inverter takes over, the automatic pilot is cut out. Therefore in the event of main inverter failure the automatic pilot must be switched off to eliminate the possibility of its re-engaging unexpectedly should the main inverter restart.

(c) *Stand-by inverter failure*

Failure of the stand-by inverter is indicated in two forms which are not necessarily apparent.

(1) Failure of the automatic pilot, if in use.

(2) Both magnetic indicators showing white when the change-over and test button is pressed.

The only remedy is to press in the lid of the circuit-breaker box.

(d) *Single generator failure*

If a generator warning light comes on, the aircrewman should attempt to re-set it by selecting the *live* generator switch to re-set for about 2 seconds and then returning the switch to normal (i.e. if No. 1 generator light comes on select No. 2 to Re-set then Normal and vice versa). If this is unsuccessful reduce the electrical load by switching off non-essential services including the auto-pilot.

(e) *Double generator failure*

If use of the re-set switches has no effect, it is recommended that all electrical services be reduced to an absolute minimum. In addition to turning off the obvious services the load may be reduced in the following manner if flight conditions permit.

To stop:—

R.T.1	Trip R.V.1 circuit-breaker in the rear cockpit

R.T.2	Trip R.V.2 circuit-breaker in the rear cockpit
Stand-by inverter	Trip the second circuit-breaker from the rear in the top row, V.P.2 (Pilot's cockpit)
Main inverter	Trip the third circuit-breaker from the rear in the top row, V.P.1. (Pilot's cockpit)

Jettison stores if necessary, while battery power is available.

122. **Relay chatter**

(a) If relay chatter occurs in flight, denoted by flickering of the generator warning lights, have one or both generators switched off momentarily. If this is impracticable or if it is unsuccessful, try momentarily switching off the V.H.F. or other suitable electrical loads.

(b) Operation of the feathering pumps, i.e. by stopping one engine, may also have the desired effect. If this method is used, it is recommended that on restarting in these circumstances, the throttle is not opened to the flight idle gate until the r.p.m. are at 15,000. This will usually obviate reverse torquing, which may start the relay chatter again.

(c) Owing to the probability of damage to the system and eventual electrical failure, relay chatter should not be allowed to persist. A normal landing should be made as soon as possible if it cannot be stopped by any of the above methods.

123. **Jettisoning the hoods**

(a) Hood jettison tests up to 250 knots have shown that all hoods jettison well clear of the aircraft. It is recommended that where circumstances permit, hoods should be jettisoned from the fully closed position in level flight at a speed between 160 and 250 knots.

(b) All hoods may be jettisoned from the open or closed position.

124. **Parachute drill**

	PILOT	CENTRE COCKPIT	REAR COCKPIT
Abandon aircraft stations.	In seat. Safety harness secured. R/T plug connected.	In Observer's seat facing forward. Safety harness secured. R/T plug connected.	In Crewman's seat facing aft. Safety harness secured. R/T plug connected.
Order of leaving.	Last.	Next to last.	First.
Action.	1. Order: "Prepare to abandon aircraft."	Acknowledge.	Acknowledge.
	2. Switch I.F.F. to distress. Carry out R/T distress procedure (if solo).	Carry out R/T distress procedure.	Carry out W/T distress procedure.
	3. Jettison or lock hood fully open. Speed *above* 160 knots to ensure rear hood clears tail fin.	Jettison or lock hood fully open, lower seat fully.	Jettison or lock hood fully open, lower seat fully.
	4. Check dinghy attachments if descent into water anticipated.	Release safety harness, check dinghy attachments if descent into water anticipated.	Release safety harness, check dinghy attachments if descent into water anticipated.
	5. Order: "Jump, Jump."	Acknowledge, disconnect R/T. Leave aircraft after Crewman.	Acknowledge, disconnect R/T. Leave aircraft immediately
	6. After ensuring that remainder of crew have jumped, release safety harness, disconnect oxygen and leave aircraft.		

	PILOT	CENTRE COCKPIT	REAR COCKPIT
Procedure.	After jettisoning hoods, reduce speed to a safe minimum. Feather propellers if possible and altitude permits. Trim the aircraft.		
	Climb on to either cockpit coaming and endeavour to launch the body on to the main plane, as near the wing root as possible.	Climb on to seat, keeping head down, and leave aircraft either side by diving towards trailing edge of mainplane.	Climb on the seat, keeping head down and leave aircraft by diving towards trailing edge of mainplane.

NOTE.—1. The best speed to jettison the rear cockpit hood is between 160 and 170 knots. Below 160 knots, there is a danger of the hood striking the tail fin.

2. There is a danger of the crewman striking the tailplane when baling out from the rear seat if the aircraft speed is too high.

3. If the aircraft is spinning, abandon the aircraft on the side which is on the outside of the spin.

125. **Crash landing drill**

	PILOT	CENTRE COCKPIT	REAR COCKPIT
Crash stations.	In seat. Safety harness secured. R/T plug connected.	In seat facing forward. Safety harness secured. R/T plug connected.	In seat facing aft. Safety harness secured. R/T plug connected.
Action before crash landing.	1. Give order "Prepare for crash landing." 2. Carry out R/T distress procedure if solo. 3. Jettison internal and external stores and close bomb bay door. 4. Check radome retracted. 5. Jettison or lock hood fully open. Retract weapon sight. 6. Release parachute harness. Check and tighten safety harness. 7. Disconnect oxygen at safe height. 8. When crash land imminent order "Brace, Brace." Release safety harness. Remove parachute harness. Leave cockpit and assist other crew members as necessary.	Acknowledge. Carry out R/T distress procedure. Retract radome. Ditch or secure any loose equipment. Lower seat fully. Jettison or lock hood fully open. Release parachute harness. Check and tighten safety harness. Acknowledge. Disconnect R/T plug and brace with hands and feet against convenient structure. Release safety harness. Remove parachute harness. Leave cockpit and assist other crew members as necessary.	Acknowledge. Carry out W/T distress procedure. Ditch or secure any loose equipment. Lower seat fully. Jettison or lock hood fully open. Release parachute harness. Check and tighten safety harness. Acknowledge. Disconnect R/T plug and brace with hands and feet against convenient structure. Release safety harness. Remove parachute harness. Leave cockpit and assist other crew members as necessary.

Procedure.

1. **Power available**

   (i) Make a normal powered approach using flap as necessary, undercarriage as required.

   (ii) If one engine has failed, feather the propeller and make a normal single engined approach using flap as necessary.

   (iii) H.P. cock/cocks to Feather and Brake just prior to touchdown.

   (iv) When the aircraft has come to rest; turn off L.P. cocks and press the fire extinguisher buttons, switch the battery isolating switch off.

2. **No power available**

   (i) Feather the propellers if time available. Leave one L.P. cock on if the instruments are required otherwise turn them both off.

   (ii) Lower half flap and maintain a speed of 110 knots while manœuvring for the final approach.

   (iii) The final approach should be made as for a normal glide landing using full flap with undercarriage as required.

126. **Ditching drill**

	PILOT	CENTRE COCKPIT	REAR COCKPIT
Ditching stations.	In seat. Safety harness secured. R/T plug connected.	In seat facing forward. Safety harness secured. R/T plug connected.	In seats facing aft. Safety harness secured. R/T plug connected.
Action.	1. Order: "Dinghy, dinghy, prepare for ditching." 2. Switch I.F.F. to distress. Carry out R/T distress procedure if solo. 3. Jettison internal and external stores and close bomb bay doors. 4. Check radome retracted 5. Jettison or lock hood in fully open position. 6. Release parachute harness. Check security of safety harness and dinghy attachments. 7. Disconnect oxygen at a safe height (if used). 8. When ditching is imminent order "Brace, Brace."	Acknowledge. Carry out R/T distress procedure. Retract radome. Jettison or lock hood in fully open position. Ditch or secure any loose equipment. Lower seat fully. Release parachute harness. Check security of safety harness and dinghy attachments. Acknowledge. Disconnect R/T and brace with hands and feet against any convenient structure.	Acknowledge. Carry out W/T distress procedure. Jettison or lock hood in fully open position. Ditch or secure any loose equipment. Lower seat fully. Release parachute harness. Check security of safety harness and dinghy attachments. Acknowledge. Disconnect R/T and brace with hands and feet against any convenient structure. Clamp W/T key.
Action immediately the aircraft comes to rest.	Release safety harness and remove parachute harness; leave aircraft and assist other crew members as necessary.	Release safety harness and remove parachute harness; leave aircraft and assist other crew members as necessary.	Release safety harness and remove parachute harness; leave aircraft and assist other crew members as necessary.

Procedure.

1. Power available

Make a normal approach using full flap (undercarriage up) and touch down as slowly as possible in a tail down attitude.

2. No power available

(i) Feather propellers.

(ii) Lower 20° of flap and maintain 110 knots while manœuvring for the final approach.

(iii) The final approach should be made as for a normal glide landing using full flap but with undercarriage up.

NOTE.—If it is not possible to feather either or both propellers in the "no power available" case, elevator control may be insufficient for full longitudinal control below an air speed of about 100 knots, if either or both of them is windmilling in the 6° position (i.e. flight fine pitch stop(s) disengaged). In these circumstances, baling out may be desirable.

PART V

OPERATING DATA

127. Pressure error corrections

(a) *CORRECTIONS TO INDICATED AIRSPEED*

(i) *Clean*

+2½ knots at 120 knots
0 at 160 knots
−1 knot at 180 knots
−2 knots at 260 knots

(ii) *Flaps, undercarriage and hook down; bomb doors shut, radome up*

− 6 knots at 80 knots
−10 knots at 105 knots
−13 knots at 135 knots

(iii) *Bomb doors open, radome down; flaps, undercarriage and hook up*

− 1 knot at 140 knots
−2½ knots at 200 knots

(b) *CORRECTIONS TO INDICATED ALTITUDE* (feet)

(i) *Clean*

Knots	120	140	160	180	200	220	240	260
Sea level ..	+25	+10	0	−10	−25	−35	−45	−55
5,000 feet ..	+30	+10	0	−15	−30	−40	−50	−60

(ii) *Flaps, undercarriage and hook down; bomb doors shut, radome up*

Knots	80	100	120	135
Sea level	−35	−75	−115	−150

(iii) *Bomb doors open, radome down; flaps, undercarriage and hook up*

Knots	130	160	170	180	190	200
Sea level ..	−10	−15	−20	−25	−40	−50
5,000 feet ..	−15	−20	−25	−35	−45	−55

NOTE.—In addition to the above pressure errors, altimeters may read as much as 100 feet high due to instrument errors.

128. **Take-off distances**

The following take-off distances, in feet, refer to the minimum run, flaps down, that an average pilot should achieve from a runway or a steady deck. In favourable circumstances a reduction of up to 20 per cent may be achieved by an experienced pilot.

Temperature at sea level	Windspeed knots	Aircraft weight (lb.)			
		18,000	19,600	20,600	21,600
+15°C. (I.C.A.O. conditions)	0	1,120	1,370	1,520	1,690
	10	830	1,030	1,170	1,310
	20	600	760	860	970
	30	400	520	600	670
+27°C. (Temperate Summer)	0	1,300	1,580	1,780	1,970
	10	970	1,220	1,370	1,540
	20	710	890	1,010	1,140
	30	470	600	700	790
+37.7°C. (Inter-continental maximum)	0	1,480	1,810	2,040	2,270
	10	1,130	1,390	1,570	1,760
	20	820	1,030	1,170	1,380
	30	520	720	820	940
+45°C. (Tropical summer)	0	1,620	1,980	2,240	2,500
	10	1,250	1,540	1,740	1,940
	20	900	1,140	1,300	1,460
	30	600	800	920	1,030

129. **Catapult take-off**

The aircraft is cleared for catapulting either clean or with any of the permitted stores (see Appendix I).

	Take-off weight (lb.)				
	19,600	20,000	20,500	21,000	21,600
Min. launching speed (knots) T.A.S.	78	79	80	81	82
Max. acceleration (g)	3.5	3.5	3.5	3.5	3.5
Catapult end-speed (knots) (Nominal stroke)					
B.H.5 catapult ..	78	78	78	78	78
B.S.4 (103 ft.) ..	85	85	85	85	85
B.S.4 (151 ft.) ..	96	96	96	96	96
Min. wind down catapult (kts.)					
B.H.5 catapult ..	0	1	2	3	4
B.S.4 (103 ft.) ..	− 7	− 6	− 5	− 4	− 3
B.S.4 (151 ft.) ..	−18	−17	−16	−15	−14

130. **Arrested landings**

The overload landing case is to be considered an emergency case only and every effort must be made to land on centre and to keep the approach speed and the rate of descent as low as possible. Arrested landings with the stores detailed in Appendix I are permitted, but an arrested landing with R.P. in tier stowage may result in failure of the shear pins with the consequent shedding of the R.P.s.

	17,900 lb.	19,800 lb.	21,500 lb.
Recommended approach speed (kts.)	85 to 90	95	100
Maximum approach speed ..	92 TAS	96 TAS	96 TAS
Max. retardation on centre ..	2.2 g	2.0 g	2.0 g
Min. wind required:—			
Mk. 10 and 11 unmodified ..	20	26	26
Mk. 10 Mod. 1 & 11 Mod. 1 ..	15	21	21
Mk. 12	11	17	17
Mk. 13	5	11	11

131. **Endurance**

The speed for maximum endurance at all altitudes in calm air conditions is 115–140 knots, depending on the A.U.W. Where practicable this should be done on one engine only. In conditions of severe turbulence or when under I.F.R. this speed should be increased to 130 knots. Except in conditions of icing, severe turbulence, or where flight conditions make a change in altitude desirable, there is little or no advantage to be gained by climbing when flying for maximum endurance.

132. **Flight planning data**

The following tables show the climb, cruise and descent data in tabular form. The climb and descent tables give time taken, fuel used and distance covered to and from various heights, as well as the speed for best rate of climb. The cruise tables show A.N.M./100 lb., and fuel flow in pounds per hour, at various heights and airspeeds, at two weights, and for one and two engines. Figures may be interpolated for intermediate weights or heights.

CLIMB

The following figures are based on a two-engined climb at maximum continuous power, starting at a weight of 21,600 and 19,600 lb. It is assumed that 80 lb. fuel are used for take-off.

Altitude Ft.	Recommended Climb speed Kts. I.A.S.	A.U.W. = 19,600 lb.			A.U.W. = 21,600 lb.		
		Time Min.	Distance N.M.	Fuel used (lb.)	Time Min.	Distance N.M.	Fuel used (lb.)
0	140	—	—	80	—	—	80
2,000	138	1.0	2	115	1.2	2	122
5,000	135	2.7	7	172	3.2	8	189
10,000	130	6.2	15	275	7.5	18	331
15,000	125	11.0	28	399	13.7	34	491
20,000	120	18.7	48	571	25.5	66	758

DESCENT

The following figures are based on a weight of 18,000 lb. and a descent at 135 knots I.A.S. with both engines at flight idle.

Altitude Ft.	Time Minutes	Distance N. miles	Fuel used (lb.)
20,000	13	35	120
15,000	10½	26	100
10,000	7	17½	76
5,000	3½	9	40
2,000	1½	3½	20

CRUISE

ONE ENGINE—RADOME UP

		Weight (lb.)	I.A.S. Knots									
			130	135	140	145	150	155	160	165	170	175
2,000 feet	ANM/100 lb.	21,000	–	–	–	15.55	15.81	15.94	16.0	–	–	–
		19,000	–	16.11	16.32	16.55	16.72	16.81	16.83	16.72	–	–
		17,000	16.83	17.15	17.42	17.59	17.70	17.75	17.73	17.64	17.46	17.22
	lb./hour	21,000	–	–	–	957	977	1,001	1,030	–	–	–
		19,000	–	866	883	903	924	949	979	1,016	–	–
		17,000	796	811	828	849	873	899	929	963	1,002	1,046
5,000 feet	ANM/100 lb.	21,000	–	–	–	16.54	–	–	–	–	–	–
		19,000	–	17.00	17.27	17.53	17.75	17.81	–	–	–	–
		17,000	17.85	18.19	18.46	18.68	18.80	18.84	18.80	18.67	–	–
	lb./hour	21,000	–	–	–	945	–	–	–	–	–	–
		19,000	–	856	873	892	913	937	–	–	–	–
		17,000	785	800	817	837	860	886	917	953	–	–
		Weight (lb.)	130	135	140	145	150	155	160	165	170	175
			I.A.S. Knots									

ONE ENGINE—RADOME DOWN

		Weight (lb.)	I.A.S. Knots							
			125	130	135	140	145	150	155	160
2,000 feet	ANM/100 lb.	21,000	—	—	—	14.37	14.53	—	—	—
		19,000	—	14.86	15.06	15.25	15.33	15.34	15.22	—
		17,000	15.53	15.81	16.0	16.13	16.20	16.20	16.08	15.9
	lb./hr.	21,000	—	—	—	1,004	1,028	—	—	—
		19,000	—	901	923	946	974	1,008	1,048	—
		17,000	829	847	869	894	922	954	993	1,037
5,000 feet	ANM/100 lb.	21,000	—	—	—	—	—	—	—	—
		19,000	—	15.82	15.97	16.09	—	—	—	—
		17,000	16.53	16.80	16.98	17.10	17.08	17.03	—	—
	lb./hour	21,000	—	—	—	—	—	—	—	—
		19,000	—	885	911	938	—	—	—	—
		17,000	815	834	857	882	915	949	—	—
		Weight (lb.)	125	130	135	140	145	150	155	160
			I.A.S. Knots							

TWO ENGINES—RADOME UP

		Weight (lb.)	I.A.S. Knots									
			140	150	160	170	180	190	200	210	220	230
2,000 feet	ANM/100 lb.	21,000	—	11.47	11.82	12.06	12.17	12.23	12.17	12.02	11.81	11.51
		19,000	11.45	11.93	12.26	12.44	12.56	12.56	12.47	12.27	12.03	11.72
		17,000	11.93	12.38	12.72	12.89	12.94	12.89	12.74	12.54	12.27	11.93
	lb./hour	21,000	—	1,347	1,394	1,452	1,523	1,601	1,693	1,800	1,920	2,058
		19,000	1,260	1,295	1,345	1,403	1,476	1,559	1,652	1,764	1,885	2,021
		17,000	1,209	1,247	1,296	1,359	1,434	1,519	1,616	1,726	1,848	1,986
5,000 feet	ANM/100 lb.	21,000	—	12.41	12.74	12.93	12.97	12.94	12.84	12.72	12.55	—
		19,000	12.46	12.96	13.24	13.39	13.38	13.32	13.16	13.00	12.79	—
		17,000	13.03	13.51	13.76	13.87	13.84	13.70	13.51	13.28	13.04	12.59
	lb./hour	21,000	—	1,301	1,353	1,417	1,495	1,583	1,679	1,780	1,889	—
		19,000	1,212	1,247	1,303	1,371	1,450	1,538	1,635	1,740	1,853	—
		17,000	1,158	1,196	1,253	1,321	1,404	1,496	1,595	1,704	1,819	1,968
10,000 feet	ANM/100 lb.	21,000	—	13.92	14.24	14.39	14.41	14.31	14.14	—	—	—
		19,000	14.20	14.64	14.90	14.97	14.94	14.78	14.53	—	—	—
		17,000	15.04	15.39	15.52	15.53	15.41	15.15	14.85	14.50	—	—
	lb./hour	21,000	—	1,255	1,310	1,376	1,455	1,546	1,648	—	—	—
		19,000	1,148	1,194	1,251	1,322	1,403	1,496	1,604	—	—	—
		17,000	1,084	1,136	1,200	1,275	1,360	1,460	1,568	1,686	—	—
15,000 feet	ANM/100 lb.	21,000	—	15.50	15.75	15.82	15.73	—	—	—	—	—
		19,000	15.91	16.33	16.50	16.52	16.40	16.05	—	—	—	—
		17,000	16.80	17.12	17.27	17.24	17.04	16.66	—	—	—	—
	lb./hour	21,000	—	1,221	1,281	1,355	1,444	—	—	—	—	—
		19,000	1,110	1,159	1,223	1,297	1,385	1,493	—	—	—	—
		17,000	1,051	1,105	1,168	1,243	1,332	1,439	—	—	—	—
		Weight (lb.)	140	150	160	170	180	190	200	210	220	230
			I.A.S. Knots									

PART V—OPERATING DATA

TWO ENGINES—RADOME DOWN

		Weight (lb.)	I.A.S. Knots								
			140	150	160	170	180	190	200	210	220
2,000 ft.	ANM/ 100 lb.	21,000	10.67	10.94	11.12	11.23	11.23	11.15	10.99	10.73	—
		19,000	11.04	11.34	11.50	11.55	11.53	11.42	11.22	10.92	—
		17,000	11.46	11.75	11.86	11.89	11.83	11.68	11.44	11.13	10.80
	lb./ hour	21,000	1,352	1,412	1,481	1,559	1,650	1,754	1,873	2,016	—
		19,000	1,306	1,362	1,433	1,516	1,608	1,713	1,835	1,981	—
		17,000	1,258	1,315	1,389	1,473	1,567	1,675	1,799	1,942	2,097
5,000 ft.	ANM/ 100 lb.	21,000	11.40	11.70	11.89	11.95	11.90	11.78	11.61	—	—
		19,000	11.82	12.11	12.27	12.24	12.22	12.08	11.85	—	—
		17,000	12.25	12.48	12.61	12.63	12.55	12.39	12.15	11.85	—
	lb./ hour	21,000	1,324	1,381	1,450	1,534	1,630	1,739	1,856	—	—
		19,000	1,277	1,335	1,406	1,491	1,588	1,695	1,818	—	—
		17,000	1,232	1,295	1,367	1,450	1,545	1,653	1,774	1,911	—
		Weight (lb.)	140	150	160	170	180	190	200	210	220
			I.A.S. Knots								

APPENDIX 1

Armament loadings—Speeds for carriage and release

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	
Training Role 1							
Anti-Sub. Training Indicators No. 1 Mk. 1	Bomb bay	4	300	30°	200	30°	Jettison at speeds up to 300 knots and angles of dive up to 30°.
Directional Sonobuoy T. 1946	Bomb bay	5	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys. If not, release speed is restricted to 200 knots I.A.S.
Omni-directional Sonobuoys T. 1945	Wing	6	300	30°	230	Straight and level	
Markers Marine No. 2 Mk. 1 and No. 2 Mk. 2	Bomb bay doors	6	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	
Training Role 2							
18 in. Mk. 30 Torpedo	Bomb bay	1	300	30°	240	Straight and level	Jettison at speeds up to 280 knots I.A.S. and angles of dive up to 30°.

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	
Training Role 2—*continued*							
Directional Sonobuoy T. 1946	Bomb bay	6	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys. If not, release speed is restricted to 200 knots I.A.S.
Omni-directional Sonobuoys T. 1945	Bomb bay	12	300	30°	230	30°	
Markers Marine No. 2 Mk. 1 and No. 2 Mk. 2	Bomb bay doors	6	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	
Anti-Sub. Training Indicators No. 1 Mk. 1	Wing. Bomb bay door (Port)	4 1	300	30°	200	30°	Jettison at speeds up to 300 knots I.A.S. and angles of dive up to 30°.
Training Role 3							
R.P.s 60 or 25 lb. Head	Wing	Up to 16	350	60°	350	60°	Single or tier stowage.
or Flare Head	Wing	Up to 16	350	60°	350	20° climb	
Practice Bombs 10, 11½ and 25 lb.	Bomb bay	12	300	50°	300	50°	The carriers are not jettisonable but bombs may be jettisoned up to limiting speed and 50° dive.

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	
Training Role 4							
R.P.s Flare Head	Wing	Up to 16	350	60°	350	20° climb	Single or tier stowage.
Anti-Sub. Training Indicators No. 1 Mk. 1	Bomb bay	8	300	30°	180	Straight and level	Jettison at speeds up to 300 knots I.A.S. and angles of dive up to 30°.
Directional Sonobuoy T. 1946	Bomb bay	5	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys, if not, release speed is restricted to 200 knots I.A.S.
Omni-directional Sonobuoy T. 1945	Wing	6	300	30°	230	30°	
Markers Marine No. 2 Mk. 1 and No. 2 Mk. 2	Bomb bay doors	6	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	
Training Role 5							
3½ lb. No. 1 Mk. 1 Smoke/ Flame Floats	Bomb bay	12	300	50°	220	50° 2G Applied	If these stores are released at speeds in excess of 220 knots, they may strike either the radome or after end of bomb bay doors.

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	

Training Role 5—*continued*

Markers Marine No. 2 Mk. 1 and No. 2 Mk. 2	Bomb bay doors	6	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	

Training Role 6

4.5 in. Flares No. 1 Mk. 1, No. 2 Mk. 1 and No. 3 Mk. 1 fitted with No. 848 fuses	Bomb bay and Bomb bay doors	4 4	Maximum limitation of aircraft Bomb doors closed, 280 knots Bomb doors open	30°	200	Straight and level	No facilities exist for jettison of flares in Bomb bay. Flares on Bomb bay doors may be jettisoned under the same conditions as are given for Release.
Practice Bombs 10, 11½ or 25 lb.	Bomb bay	8	300 200 Bomb doors open	50° 2G applied after release of flares Gentle manœuvres	300 200	50° 2G applied after release of flares Straight and level before release of flares	The carriers are not jettisonable but bombs may be jettisoned up to limiting speed and 50° dive.
R.P.s Flare Head	Wing	Up to 8	350	60°	350	20° climb	Single or tier stowage.

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	
Training Role 7							
Practice Bombs 10, 11½ or 25 lb.	Bomb bay	12	300	50°	300	50°	The carriers are not jettisonable, but bombs may be jettisoned up to the limiting speed and at dive angles up to 50°.
R.P.s Flare Head	Wing	Up to 12	350	60°	350	20° climb	Single or tier stowage.
Training Role 8							
Practice Bombs 10, 11½ or 25 lb.	Bomb bay	4	300	50°	300	50°	The carriers are not jettisonable, but bombs may be jettisoned up to the limiting speed and angles of dive up to 50°.
R.P.s 60 or 25 lb. Head	Wing	Up to 8	350	60°	350	60°	Single or tier stowage.
R.P.s Flare Head	Wing	Up to 8	350	60°	350	20° climb	Single or tier stowage.
Directional Sonobuoy T. 1946	Bomb bay	5	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys otherwise release speed is restricted to 200 knots I.A.S.
Omni-directional Sonobuoy T. 1945	Bomb bay	4	Maximum limitation of aircraft		200	30°	

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	
Training Role 9							
Anti-Sub. Training Indicators No. 1 Mk. 1	Bomb bay	4	300	30°	200	30°	Jettison at speeds up to 300 knots I.A.S. and angles of dive up to 30°
R.P.s 60 or 25 lb. Head	Wing	Up to 8	350	60°	350	60°	Single or tier stowage.
or R.P.s Flare Head	Wing	Up to 8	350	60°	350	20° climb	Single or tier stowage.
Directional Sonobuoy T. 1946	Bomb bay	5	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys otherwise release speed is restricted to 200 knots I.A.S.
Omni-directional Sonobuoys T. 1945	Bomb bay	4	Maximum limitation of aircraft		200	30°	
Training Role 10							
Omni-directional Sonobuoys T. 1945	Bomb bay	4	Maximum limitation of aircraft		200	30°	
Operational Role 1(a)							
18 in. Mk. 30 Torpedo	Bomb bay	1	300	30°	240	Straight and level	Jettison at speeds up to 280 knots I.A.S. and angles of dive up to 30°.

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	

Operational Role 1(a)—*continued*

Directional Sonobuoy T. 1946	Bomb bay	6	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys otherwise release speed is restricted to 200 knots I.A.S.
Omni-directional Sonobuoy T. 1945	Bomb bay	12	300	30°	230	30°	
Markers Marine No. 2 Mk. 1 and No. 2 Mk. 2	Bomb bay doors	6	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	

Operational Role 1(b)

18 in. Mk. 30 Torpedo	Bomb bay	2	300	30°	240	Straight and level	Jettison at speeds up to 280 knots and angles of dive up to 30°.
Directional Sonobuoy T. 1946	Bomb bay	5	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys otherwise release speed is restricted to 200 knots I.A.S.
Omni-directional Sonobuoy T. 1945	Wing	12	300	30°	230	30°	

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	

Operational Role 1(b)—*continued*

Markers Marine No. 2 Mk. 1 and No. 2 Mk. 2	Bomb bay doors	6	300	30°	250	30°	
or Markers Marine No. 4 Mk. 4	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	

NOTE.—Up to eight Rockets flare head or R/P may be carried in lieu of Omni-directional Sonobuoys and Markers Marine under limitations as for Operational Role 3.

Operational Role 2

Depth Charge 250 lb. Mk. 11* and Mk. 11 Mod. 2	Bomb bay	Up to 6	300	30°	250	30°	
Directional Sonobuoy T. 1946	Bomb bay	5	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys, if not, release speed is restricted to 200 knots I.A.S.
Omni-directional Sonobuoy T. 1945	Wing	12	300	30°	230	30°	
Markers Marine No. 2 Mk. 1 and No. 2 Mk. 2	Bomb bay doors	4	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	

Operational Role 3

R.P.s 60 or 25 lb. Head	Wing	Up to 16	350	60°	350	60°	Single or tier stowage.
Directional Sonobuoy T. 1946	Bomb bay	5	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys. If not, release speed is restricted to 200 knots I.A.S.
Omni-directional Sonobuoy T. 1945	Bomb bay	18	300	30°	230	30°	
Markers Marine No. 2 Mk. 1 and No. 2 Mk. 2	Bomb bay doors	6	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	

Operational Role 4

18 in. Mk. 30 Torpedo	Bomb bay	1	300	30°	240	Straight and level	Jettison at speeds up to 280 knots I.A.S. and angles of dive up to 30°.
R.P.s 60 or 25 lb. Head	Wing	Up to 16	350	60°	350	60°	Single or tier stowage.

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	
Operational Role 4—*continued*							
Directional Sonobuoy T. 1946	Bomb bay	6	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys otherwise release speed is restricted to 200 knots I.A.S.
Omni-directional Sonobuoy T. 1945	Bomb bay	12	300	30°	230	30°	
Markers Marine No. 2 Mk. 1 No. 2 Mk. 2	Bomb bay doors	6	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	
Operational Role 5							
18 in. Mk. 30 Torpedo	Bomb bay	1	300	30°	240	Straight and level	Jettison at speeds up to 280 knots I.A.S. and at angles of dive up to 30°.
R.P.s Flare Head	Wing	Up to 8	350	60°	350	20° climb	Single or tier stowage.
Directional Sonobuoy T. 1946	Bomb bay	6	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys otherwise release speed is restricted to 200 knots I.A.S.

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	
Operational Role 5—*continued*							
Omni-directional Sonobuoy T. 1945	Bomb bay	12	300	30°	230	30°	
Markers Marine No. 2 Mk. 1 No. 2 Mk. 2	Bomb bay doors	6	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	
Operational Role 6							
S.A.R. Apparatus Type G	Wing	2	300	30°	Con-tents 170	Straight and level	Jettison of the container, loaded or empty, from Mod. 5005 carriers, is permitted at speeds up to 190 kts. Straight and level.
Markers Marine No. 2 Mk. 1 and No. 2 Mk. 2	Bomb bay doors	6	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	
4.5 in. Flares No. 1 Mk. 1, No. 2 Mk. 1 or	Bomb bay and Bomb bay doors	6	Maximum limitation of aircraft. Bomb bay door closed		200	Straight and Level	Four flares are carried in bomb bay and two on bomb bay doors. No

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	
Operational Role 6—*continued*							
No. 3 Mk. 1 fitted with No. 848 fuses			280 Bomb bay door open	30°			facilities exist for jettison of flares in the bomb bay. Flares on the bomb bay doors may be jettisoned under the same conditions as are given for Release.

NOTE.—An additional ten 4.5 in. Flares may be carried in lieu of Markers Marine at the following stations:—
2 Flares on bomb bay doors
8 Flares in bomb bay
Carriage and Release conditions are as given above for 4.5 in. Flares.

Operational Role 7

18 in. Mk. 30 Torpedo	Bomb bay	1	300	30°	240	Straight and Level	Jettison at speeds up to 280 knots I.A.S. and angles of dive up to 30°.
R.P.s 60 or 25 lb. Head	Wing	Up to 8	350	60°	350	60°	Single or tier stowage.
or R.P.s Flare Head	Wing	Up to 8	350	60°	350	20° climb	Single or tier stowage.
Directional Sonobuoy T. 1946	Bomb bay	6	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys otherwise release speed is restricted to 200 knots I.A.S.
Omni-directional Sonobuoy T. 1945	Bomb bay	4	Maximum limitation of aircraft		200	30°	

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	
Operational Role 8							
Depth Charge 250 lb. Mk. 11* and and Mk. 11 Mod. 2	Bomb bay	Up to 3	300	30°	250	30°	
R.P.s 60 or 25 lb. Head	Wing	Up to 16	350	60°	350	60°	Single or tier stowage.
or R.P.s Flare Head	Wing	Up to 16	350	60°	350	20° climb	Single or tier stowage.
Directional Sonobuoy T. 1946	Bomb bay	5	300	30°	230	30°	Mod. 2524 and 2510/2 must be embodied in the Sonobuoys otherwise release speed is restricted to 200 knots I.A.S.
Omni-directional Sonobuoy T. 1945	Bomb bay	4	Maximum limitation of aircraft		200	30°	
Operational Role 9							
500 lb. M.C. Bombs Mks. 18–21 with Nos. 25 or 112 Tails	Bomb bay	4	Maximum limitation of aircraft (Bomb bay doors open or closed)		300	50°	Gannet Mod. No. 414 must be embodied. Release and jettison single and in salvo.

Store	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	
Mining Role 1							
Mine A Mark 9	Bomb bay	1	300 (Bomb doors closed)	30°	217 (When fitted with parachute attachment No. 13 Mk. 6)	Straight and level	Mod. 421 and Mod. 5027 *must* be embodied.
			270 (Bomb doors open)	30°			
			300	30°	260 (When fitted with parachute attachment No. 13 Mk. 7)	Straight and level	
Markers Marine No. 2 Mk. 1 and No. 2 Mk. 2	Bomb bay doors	4	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	
3½ lb. Smoke and Flame Floats No. 1 Mk. 1	Chute	4	Maximum limitation of aircraft		270	30°	Mod. 147 must be embodied.
Mining Role 2							
Mine A Mark 12	Bomb bay	1	Maximum limitation of aircraft		270	Straight and level	Mod. 421 and Mod. 5027 *must* be embodied.
Markers Marine No. 2 Mk. 1 or No. 2 Mk. 2	Bomb bay doors	4	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	

Stores	Position	Number carried	Carriage		Release		Remarks
			Max. Speed I.A.S.	Max. Dive Angle	Max. Speed I.A.S.	Max. Dive Angle	
Mining Role 2—*continued*							
3½ lb. Smoke and Flame Float No. 1 Mk. 1	Chute	4	Maximum limitation of aircraft		270	30°	Mod. 147 must be embodied.
Mining Role 3							
Mine A Mark 7*	Bomb bay	2	300	30°	217	Straight and level	Jettison at speeds up to 280 knots I.A.S. and angles of dive up to 30°.
					(When fitted with parachute attachment No. 9 Mk. 5)		
					270 (When fitted with parachute attachment No. 9 Mk. 6)		
Markers Marine No. 2 Mk. 1 and No. 2 Mk. 2	Bomb bay doors	4	300	30°	250	30°	
or Markers Marine No. 4 Mk. 1	Bomb bay doors	4	Maximum limitation of aircraft		300	30°	
3½ lb. Smoke and Flame Floats No. 1 Mk. 1	Chutes	4	Maximum limitation of aircraft		270	30°	Mod. 147 must be embodied.
Mining Role 7							
Mine O Mark 1	Bomb bay	4	Maximum limitation of aircraft		300	30°	Jettison at speeds up to 300 knots I.A.S. and angles of dive up to 30°.

APPENDIX II

The following table shows take-off and landing weight and c.g. position in all the armament configurations.

Role	Take-off		Fuel (lb.)	Stores/Carrier weight (lb.)		Landing weight (lb.) 800 lb. fuel. Stores on
	Weight (lb.)	C.G. (In. Aft of Datum)				
Training						
Role 1	20,551	110.2	3,704	709	319	17,647
2	21,589	112.3	3,704	1,646	420	18,685
3	21,515	110.5	3,704	1,868	124	18,611
4	21,158	110.1	3,704	1,269	366	18,254
5	19,779	110.7	3,704	168	88	16,875
6	20,549	111.4	3,704	912	114	17,645
7	20,727	111.1	3,704	1,080	124	17,823
8	20,800	111.6	3,704	1,117	160	17,896
9	20,740	113.0	3,704	1,057	160	17,836
10	19,847	111.9	3,704	276	48	16,943
Operational						
Role 1A	21,500	112.4	3,704	1,596	383	18,596
1B	21,600	112.4	3,056	2,223	496	19,344
2	21,600	112.3	2,768	2,415	546	19,632
3	21,600	112.3	2,720	2,513	545	19,680
4	21,600	112.6	2,160	3,164	455	20,240
5	21,600	112.7	3,248	2,116	417	18,352
6	20,321	111.5	3,704	670	134	17,417
7	21,498	110.5	3,704	1,806	169	18,594
8	21,599	110.2	3,704	1,842	234	18,695
9	21,595	113.5	3,704	2,000	140	18,691
Mining						
Role 1	21,561	112.0	3,704	1,958	80	18,657
2	21,600	112.2	3,608	2,093	80	17,992
3	21,600	110.0	3,488	2,198	92	18,112
7	20,251	111.1	3,704	600	128	17,347

PART VI

ILLUSTRATIONS

KEY TO FIGURE 1

1. Parking brake
2. Wing fold safety lever
3. Wing fold selector lever
4. L.P. fuel cock lever—starboard
5. L.P. fuel cock lever—port
6. Outside air temperature gauge
7. Engine de-icing trimmer (ground use only)
8. Engine de-icing continuity indicator
9. Harness stowage hook
10. Weapon sight selector dimmer control
11. Auto-pilot pump re-set pushbutton
12. Throttle lever—port engine
13. Throttle lever—starboard engine
14. R.A.T.O.G. firing pushbutton
15. Hydraulic pressure gauge
16. Fuel recuperator warning indicators
17. Oil cooler shutter switches
18. Weapon sight spare filament stowage
19. Flight instruments normal inverter failure indicator
20. Flight instruments normal inverter changeover and test pushbutton
21. Flight instruments inverter auto-standby switch
22. Triple brake pressure gauge
23. Ignition warning lights
24. Emergency flight fine pitch stop switches
25. Jet pipe temperature control switches
26. Pilot's Notes stowage
27. Engine synchroniser switch
28. Aileron trimming switch
29. Wing locking indicator lights test switch
30. Flap selector lever
31. H.P. fuel cock lever—starboard
32. Rudder trimming control and indicator
33. Elevator trimming control and indicator
34. R.P. selector switch
35. H.P. fuel cock lever—port
36. Auto-pilot master switch
37. Auto-pilot controller
38. V.H.F. controller

39. Fire-extinguisher pushbutton—starboard engine
40. Fire-extinguisher pushbutton—engine bay
41. Fire-extinguisher pushbutton—port engine
42. Taxying lamps switch
43. Fire warning light test pushbuttons—post-mod. 329
44. Call crew pushbutton
45. V.H.F. mute switch
46. R.A.T.O.G. jettison pushbutton
47. R.A.T.O.G. master switch
48. Undercarriage selector pushbuttons
49. Bombs/R.P. selector switch
50. Pressure head heater override switch
51. Radome indicator
52. Undercarriage warning light
53. Shaft horse power gauge—port
54. Weapon sight master switch
55. Flight instruments power supply failure indicator
56. Horizon gyro fast erection pushbutton
57. Weapon sight
58. Weapon sight emergency retraction control
59. Shaft horse power gauge—starboard
60. Auto-pilot "disengaged" indicator
61. Dual jet pipe temperature gauge
62. Jet pipe temperature warning lights
63. Pilot's hood jettison control
64. Emergency hydraulic selector
65. Generator failure warning lights
66. Bomb doors selector lever
67. Oxygen regulator
68. Deck hook control lever
69. Windscreen de-icing pushbutton
70. Marker flare fusing switch
71. 2,000 lb. store selector switch
72. Deck hook indicator light
73. Windscreen wiper switch
74. Fuel transfer indicator—bomb bay tanks
75. Engine r.p.m. indicators
76. Fuel transfer indicators—wing tanks
77. Reverse torque indicators
78. Oil pressure gauge—starboard engine

79. Compass/D.G. change-over switch
80. Oil temperature gauges
81. Oil pressure gauge—port engine
82. Radio altimeter
83. Weapon sight retraction circuit fuse
84. Fuel contents pushbutton
85. Fuel contents gauge
86. Flap position and aileron trim indicator
87. Pilot's hood control lever
88. Undercarriage position indicator
89. Not used

KEY TO FIGURE 3

90. Hydraulic handpump
91. Engine de-icing overheat warning light
92. Cold air control
93. Starting fuel pumps master switch
94. Cold air vent
95. Sonobuoy indicator
96. Bomb door indicator
97. Bomb spacing unit
98. Bomb jettison pushbutton
99. Wander lamp
100. Wander lamp switch
101. Bomb fusing selector
102. IFF master switch
103. Emergency stores jettison pushbutton
104. Harness stowage fitting
105. Instrument panel u/v lighting dimmer switch
106. Battery isolating switch
107. Instrument panel floodlamps dimmer switch
108. Port side floodlamps dimmer switch
109. Circuit-breakers cover-plate
110. Hood jettison indicator
111. Starboard side floodlamps dimmer switch
112. ZBX controller
113. Harness release lever
114. Throttles locking lever
115. Flying controls locking lever

116. Electrical socket for servicing lead
117. ZBX/VHF mixer box
118. Switches, from top to bottom:—
    2,000 lb. store master switch
    Engine de-icing switch
    Alternator switch
    G.45 camera ON/OFF switch
    G.45 camera SUNNY/CLOUDY switch
119. Hydraulic handpump handle stowage
120. Switches, from top to bottom:—
    Radome emergency raising switch
    Side panels floodlamps master switch
    Instrument panel floodlamps master switch
    Emergency lamps switch
121. Switches, from top to bottom:—
    Navigation lights switch—STEADY—OFF—MORSE
    Navigation lights switch—DIM—BRIGHT
    Formation lights switch—STEADY–OFF–MORSE
    Formation lights switch—DIM–BRIGHT
    Identification lights switch—STEADY–OFF–MORSE
122. Pilot's seat adjusting lever
123. External lights master switch
124. Hot air control
125. IFF control panel
126. Engine starter pushbuttons and guard switch

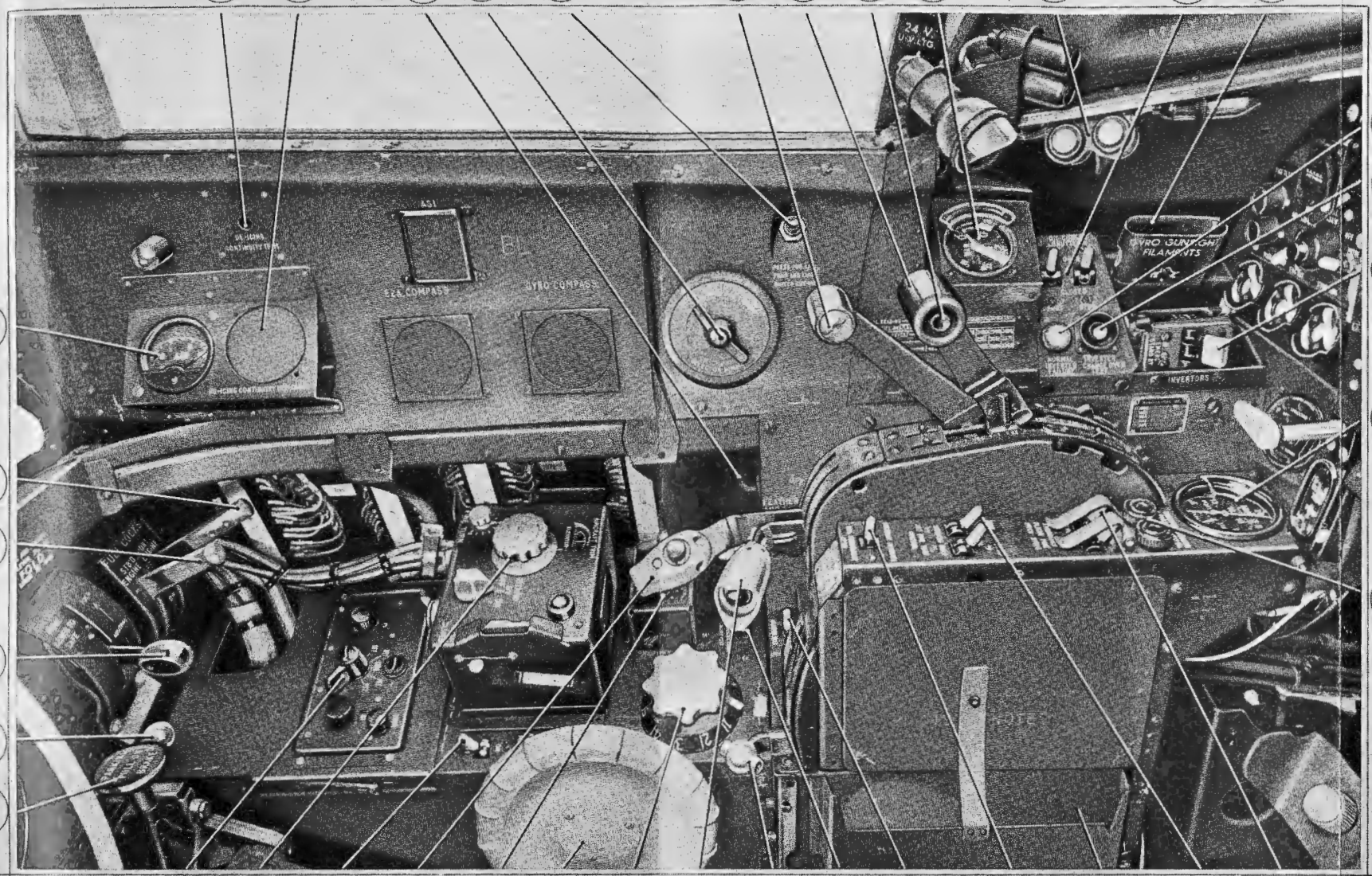
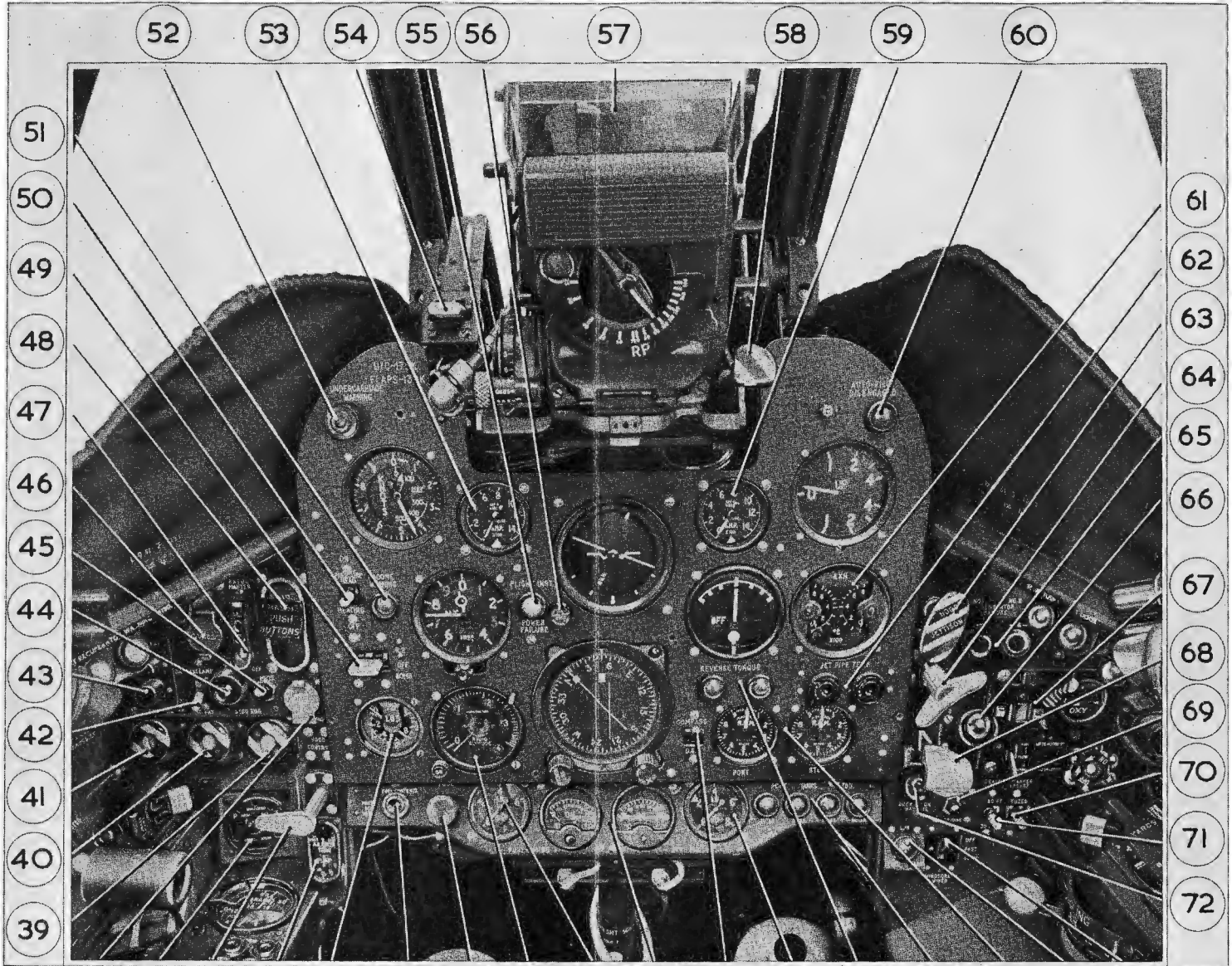


FIG. 1

COCKPIT – PORT SIDE

FIG. 1



COCKPIT—FORWARD VIEW

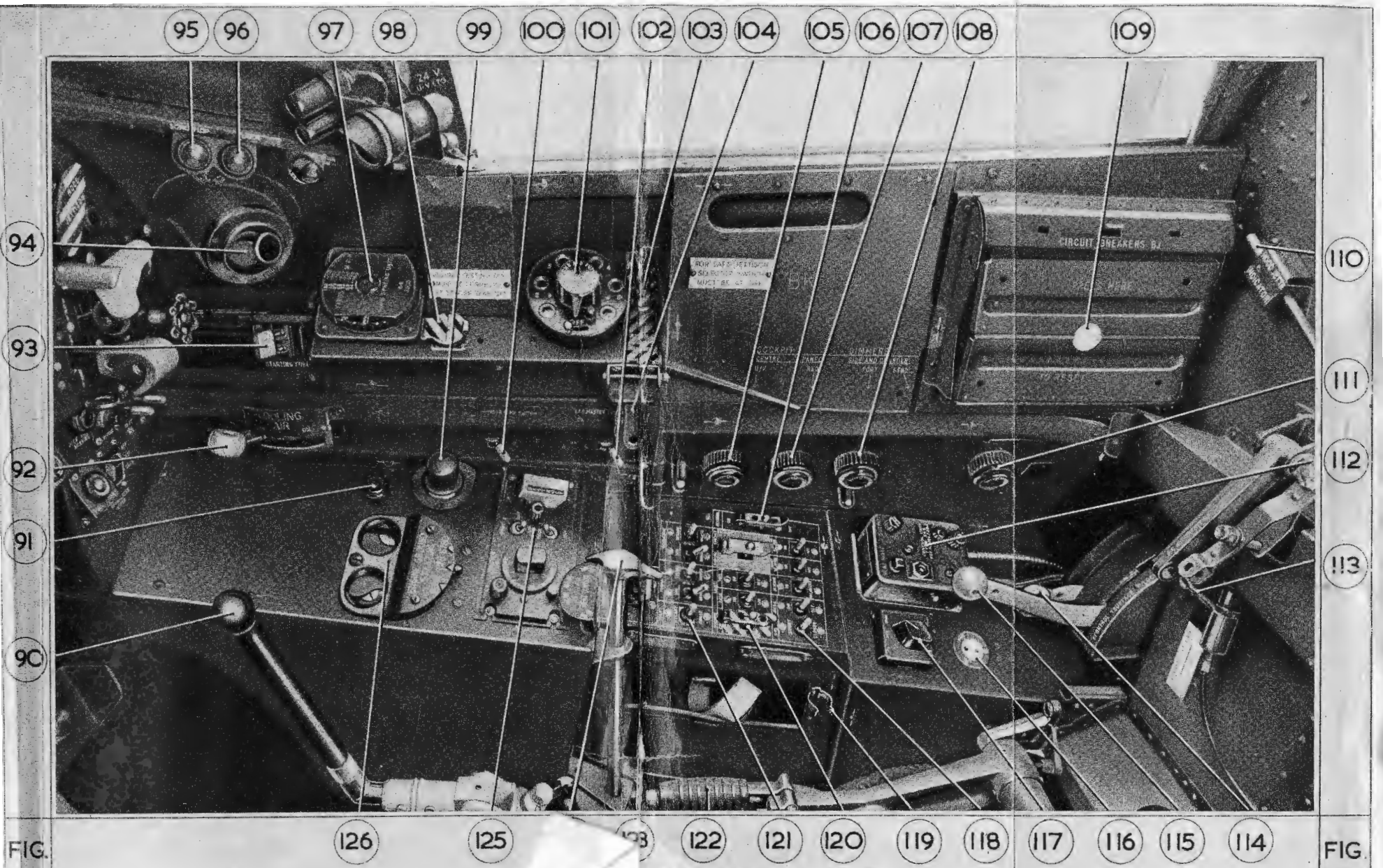


FIG. 3

C[illegible] STARBOARD SIDE

FIG. 3