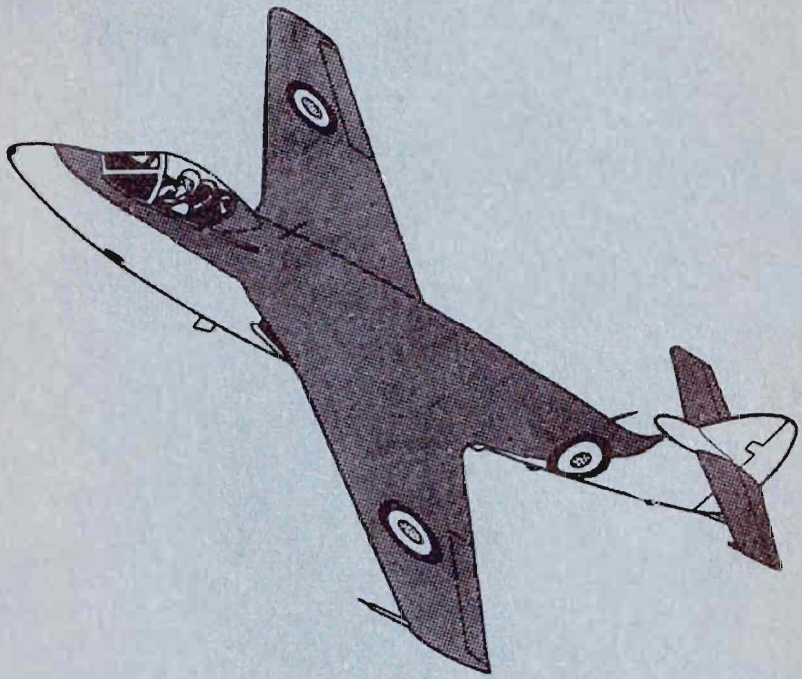
A.P.4328B to F—P.N.

PILOT'S NOTES

SEA HAWK

F.2, F.B.3 & 5 and F.G.A.4 & 6



Prepared by direction
of the
Minister of Supply

Promulgated
by command of
Their Lordships

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 Form S134D or D397. The number of the publication must be quoted in full - A.P.4328B to F—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.

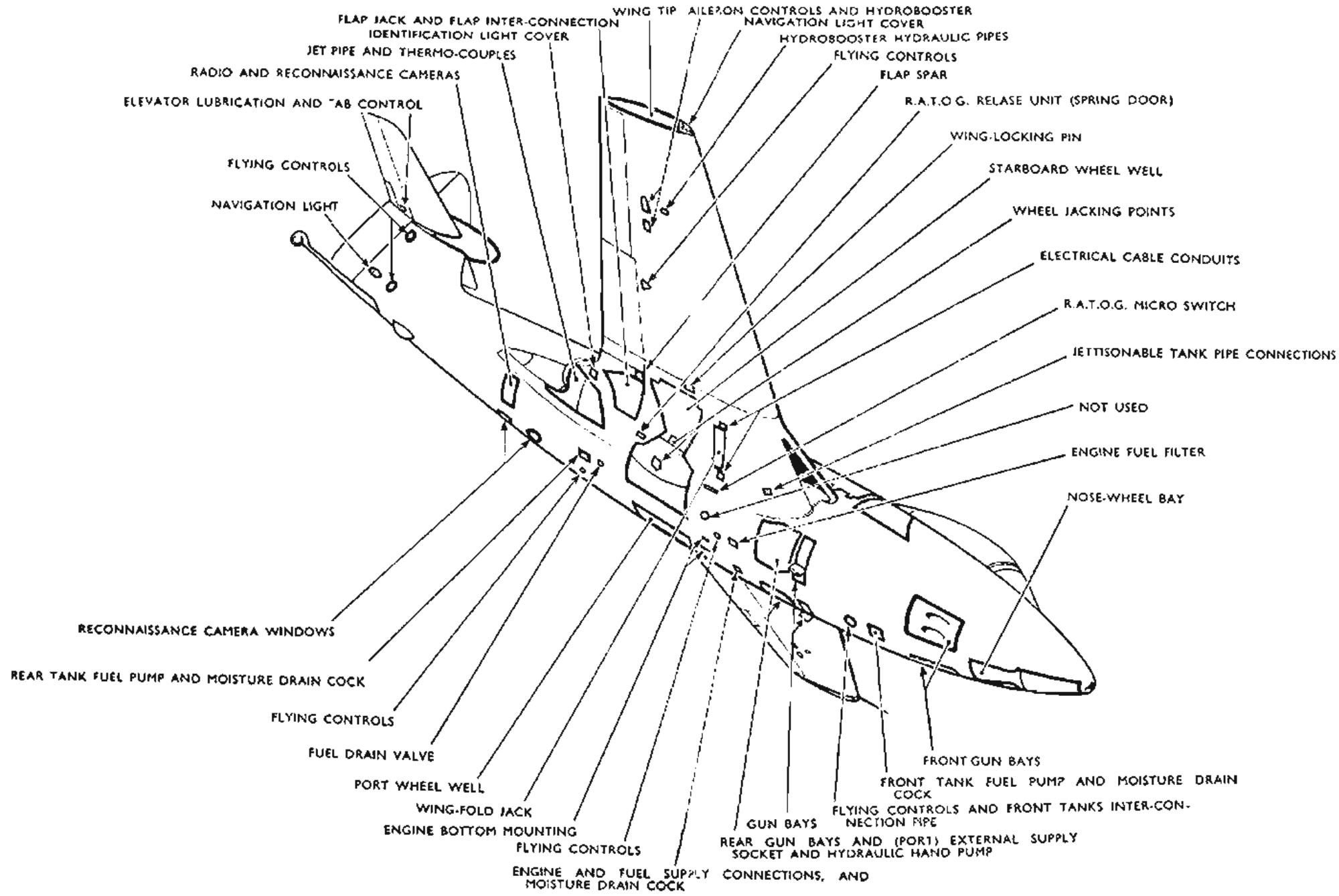
Each amendment list will, where applicable, be accompanied by gummed slips for sticking in the appropriate places in the text.

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		

LIST OF ASSOCIATED PUBLICATIONS

	A.P.
Cine camera and accessories	1355 series
Dowty aircraft hydraulic equipment	1803 D.E.
Ejection equipment	4288 N
Electrical equipment	1095 series
	4343 series
Fuel system components—gas turbines ...	4282 A
Gunsights	1275 E
Hispano 20 mm. guns	1641 F
Instrument manual	1275 series
Nene Mk. 101 and 103 aero engines	4167 B. C. D.
Powered flying control units and equipment (Fairey)	4500 A Vol. 1
Pressurising and air conditioning equipment	4340
Starting systems	1181 series
Sea Hawk aircraft, general and technical information	4328 B to F Vol. 1.



LEADING PARTICULARS:

Wing Span

Wings spread	39 ft.
Wings folded (clean)	13 ft. 3 in.
Wings folded (stores)	13 ft. 11 in.

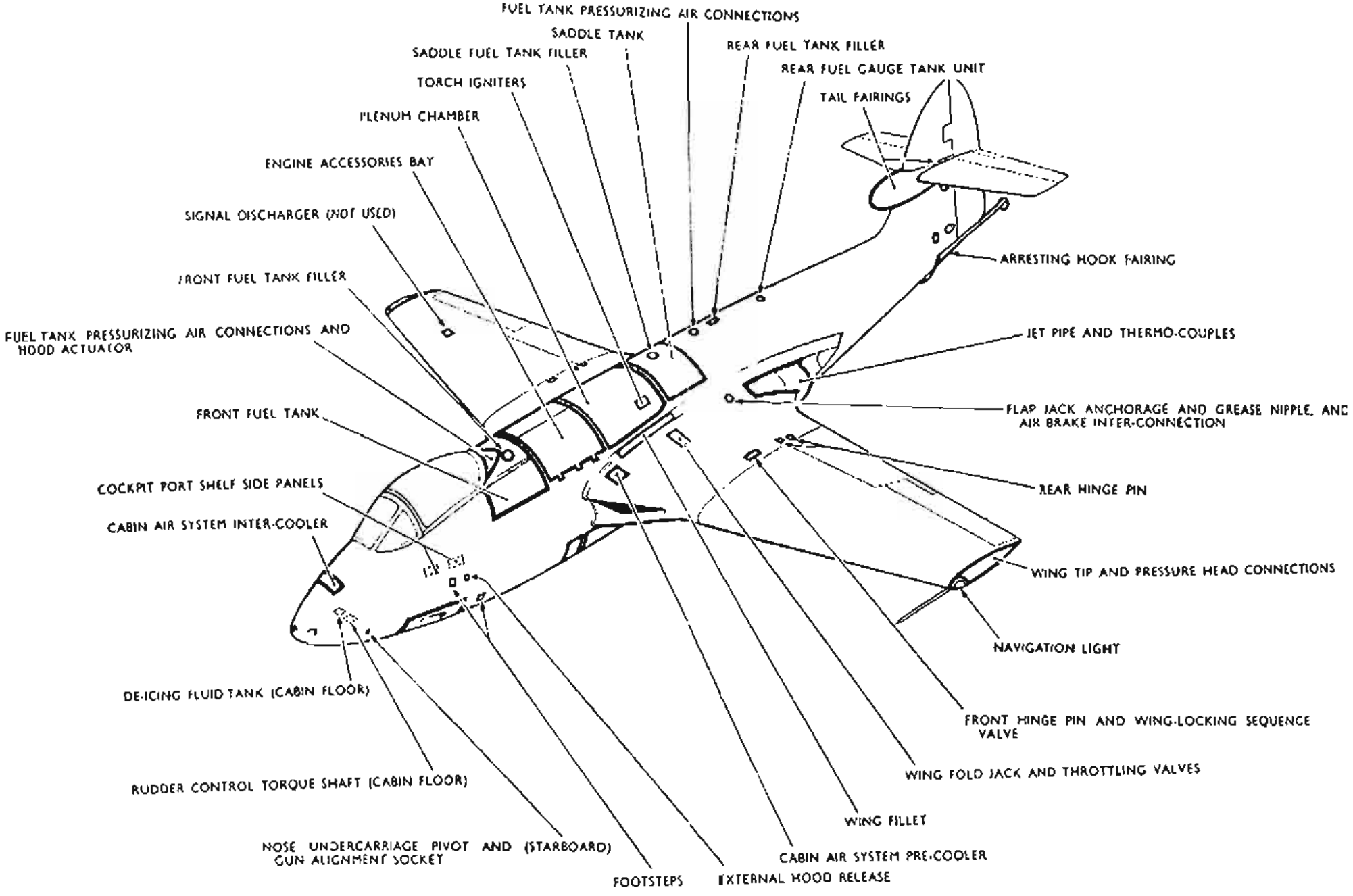
Height

Wings spread	8 ft. 9 in.
Wings folded	16 ft. 9 in.
Max. height during folding	18 ft. 10 in

Length overall ..... 40 ft.

SEA HAWK

F.2, F.B. 3 & 5 and F.G.A. 4 & 6.



DOORS AND PANELS

SEA HAWK F.2, F.B.3 & 5 and F.G.A.4 & 6

NOTE.—This edition supersedes and cancels the 1st edition of the F.2, F.B.3 and F.G.A.4 issued in April, 1954. It includes the first edition of the F.B.5 and F.G.A. 6.

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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 VII.

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

(d) Fuel poundage figures are all calculated at 8 lb./gall. (AVTUR).

(e) Where r.p.m. figures are given they are for Nene 101. Where two sets of figures are given, the figures in brackets are for Nene 103.

1. Introduction

(a) The Sea Hawk F.2 is a single-seat mid-wing naval fighter. The FB.3 & 5 and FGA.4 & 6 are F2 aircraft modified for fighter-bomber and fighter ground-attack roles respectively. Bombs can be carried beneath the inner stub wing on all but the F2 aircraft. Rockets or additional bombs can be carried beneath the outer wing on the Mks. 4 & 6 only.

(b) The power unit in the Mks. 2, 3 & 4 aircraft is a Nene 101 engine developing 5,000 lb. static thrust at sea level. In the Mks. 5 & 6 a Nene 103 which develops 5,300 lb. is fitted.

(c) Each aircraft is fitted with powered ailerons, a Mk. 2D ejection seat and catapult and RATO gear.

FUEL AND OIL SYSTEMS

2. **Fuel tanks**

(a) Fuel is carried in four flexible crashproof tanks, two forward and two aft of the engine. Each pair of tanks are interconnected and each pair act as one unit.

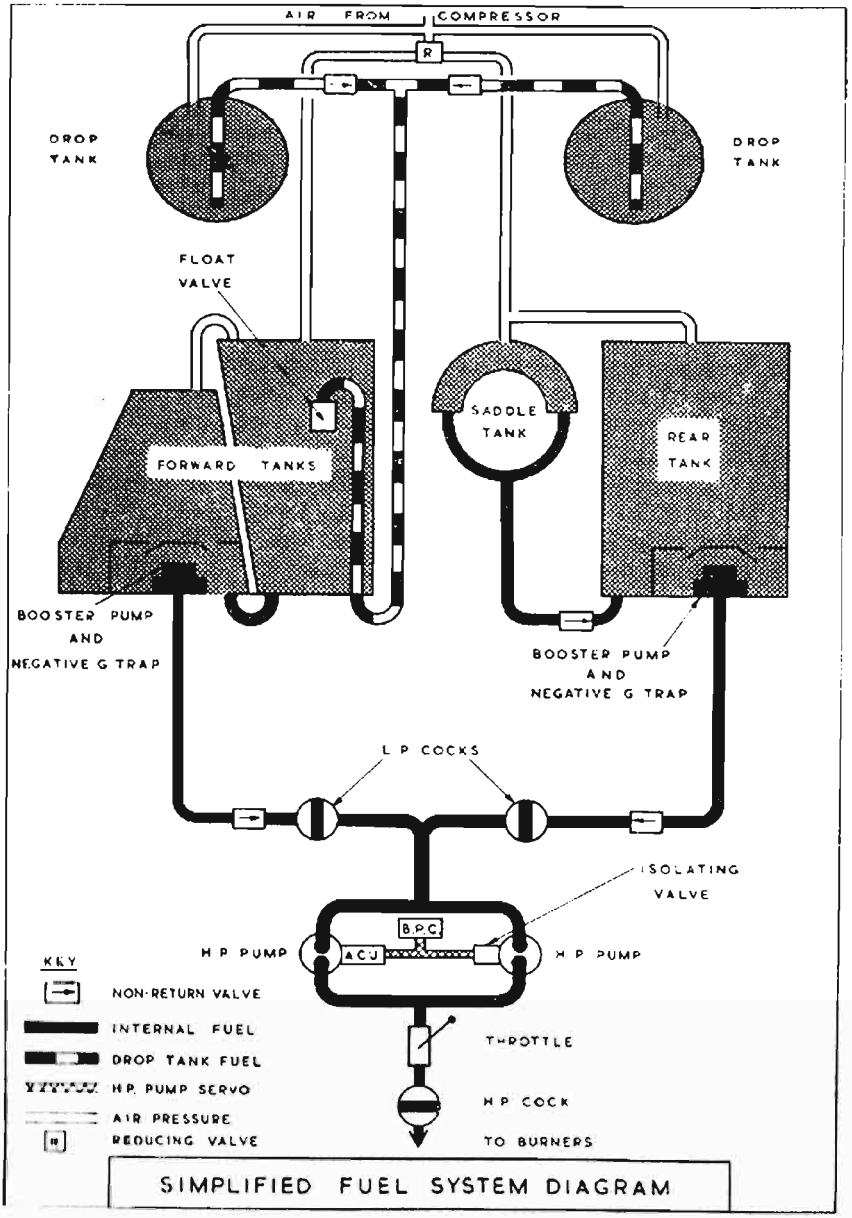
(b) Two 88 gallon steel (Mod. N.1001) or 75 gallon plastic (Mod. N.1015) wing drop tanks may be fitted on the wing stubs inboard of the wing-fold position. They may be jettisoned by means of a switch (93) on the starboard shelf, provided that electric and hydraulic power is available.

(c) The capacities of the tanks are:—

	Galls.	Pounds (at 8 lb./gall.)
Forward tanks group ...	185	1,480
Rear tanks group	212	1,696
Total (internal) ...	397	3,176
Drop tanks (2 × 88) ...	176	1,408
Total (all tanks) ...	573	4,584

NOTE.—If plastic drop tanks are fitted the fuel capacity is reduced by 26 gallons (208 lb.).

(d) A fuel tank depressurising valve, fitted beneath the nose of the aircraft, must be operated prior to removing the fuel tank filler caps.



SIMPLIFIED FUEL SYSTEM DIAGRAM

3. **Drop tanks transfer system**

Fuel is transferred from the wing drop tanks to the forward fuselage tanks by air pressure tapped from the engine compressor. The system is fully automatic, transfer commencing when approximately 20 gallons have been used from the forward tanks. The rate of transfer is controlled by a float-operated valve in the forward tanks.

4. **Main fuel system**

(a) In order to maintain the C.G. within close limits, the fuel delivery from both fuselage tank groups is automatically controlled by booster-pumps, assisted by air pressure, at a rate determined by a fuel balancer system, through the L.P. cocks to the two H.P. pumps.

(b) From the H.P. pumps fuel passes to the throttle valve and thence to the H.P. cock. When the H.P. cock is open, fuel flows at a pressure set by the throttle valve and B.P.C. to the burners.

(c) A barometric pressure control (B.P.C.) controls the delivery pressure of the H.P. fuel pumps, but in order to maintain constant r.p.m. when climbing it is necessary to throttle back progressively.

(d) An acceleration control unit (A.C.U.) is fitted. The unit is ineffective when the isolating valve switch is at ISOLATE. (See para. 8.)

5. **Fuel balancer system**

(a) The balancer system is controlled by the fuel contents gauges. Should one tank group tend to empty faster than the predetermined rate, then the booster-pump output of that group will be reduced until the fuel levels are again approximately correct.

(b) The booster-pumps control switch (98) on the cockpit starboard shelf operates the system as follows:—

NORMAL (forward)	Automatic control as in (a) above.
OFF (central)	Booster-pumps inoperative, gravity and air pressure feed.
RELIGHT & EMERGENCY (aft)	Both booster-pumps are operating at maximum output and automatic balancing is not in operation.

(c) Mounted adjacent to the control switch are two circuit breakers (100 & 97) one for each booster-pump, and between them is a warning light panel (99) containing three lights. The centre lamp will be illuminated in the event of failure of one or other of the fuses protecting the balancing unit relays, providing the control switch is set to NORMAL. The remaining lights indicate in the event of booster-pump failure. With the control switch set to NORMAL both lights will be illuminated but the faulty pump will be indicated by the greater brilliance of its lamp. With the control switch set at RELIGHT & EMERGENCY, however, both lamps will burn at half brilliance.

(d) A warning light (48) operated by a pressure switch in the low pressure fuel line on the engine indicates when the fuel pressure falls below the normal booster-pump pressure of 10-12 lb./sq. in.

(e) An ammeter socket and a test switch are fitted at the rear end of the starboard shelf for ground testing the pumps.

(f) *Booster-pump failures*

(i) If either booster-pump circuit is overloaded the affected circuit-breaker trips and the fore and aft warning lights come on under the common screen.

Failure of either pump circuit switches off both booster-pumps. If the fault is of a temporary nature re-setting the affected circuit-breaker causes the pumps to work again and the lights to go out. If the fault is permanent the lights remain on and the pumps are inoperative.

(ii) If the central light under the common screen comes on and the fuel gauges register zero, failure of the balancer system is indicated. A standby circuit for the fuel gauges operates when the booster-pumps switch is set to EMERGENCY & RELIGHT. The gauges should again indicate but automatic balancing is not possible.

6. **L.P. fuel cocks**

(a) The L.P. cock control levers (8) are on the cockpit port shelf. They are moved forward to ON. They must not normally be used to stop the engine but should be set to OFF when the engine has stopped turning, to prevent fuel seeping to the combustion chambers.

(b) Both levers can, and should normally, be moved forward or aft together. If, however, only one lever is moved aft, a spring lock prevents the other lever from being moved aft.

7. **H.P. fuel cock**

(a) The H.P. fuel cock ON-OFF lever (3) is on the port shelf. It should always be used to stop the engine. A catch retaining it in the ON (forward) position is usually fitted.

(b) A relight pushbutton is in the end of the lever.

8. **H.P. fuel pumps and isolating valve**

(a) To ensure correct and equal fuel delivery from each H.P. fuel pump at a given throttle setting, their stroke (i.e., output pressure) is servo controlled by a single B.P.C.

However, should this fail or should there be a leak in the servo pipe-line, both pumps would then operate at minimum stroke and cause engine failure. To prevent this, one pump can be isolated from the B.P.C. servo control system and will continue to deliver fuel to the engine. The fuel so delivered is sufficient at heights above 16,000 ft. to satisfy the full engine fuel requirements. Below 16,000 ft. the single pump cannot fully satisfy the engine requirements, the difference between supply and demand becoming progressively greater with decreasing altitude, until at sea level only 65% of the normal maximum thrust is available. The H.P. pump isolating valve switch (71) at the forward end of the cockpit starboard shelf should be set to ISOLATE (warning light (72) on) if there is an inexplicable drop in r.p.m.

(b) To prevent a rich extinction when the throttle is opened rapidly at low altitudes an A.C.U. overrides the B.P.C. and ensures that an acceptable air/fuel mixture is maintained under these conditions.

9. **Fuel contents gauges**

Two electrical fuel contents gauges (54 & 55), one for the forward tanks group and one for the rear tanks group, are fitted on the starboard side of the instrument panel. On early aircraft they indicate the contents in gallons, on later aircraft they indicate the contents in pounds. The scales of the volume gauges can be set for operation on either AVTUR or AVGAS.

10. **Fuel tanks fire warning light**

The TANKS FIRE warning light (44) on the left of the G.G.S. indicates fire in the vicinity of the fuel tanks. No extinguishing action can be taken.

11. **Oil system**

Oil is carried in the engine sump only, the capacity of which is 9 pints. An oil pressure gauge is mounted on the starboard side of the instrument panel.

ENGINE CONTROLS

12. **Throttle control**

The throttle control lever (15) is in a quadrant on the port side of the cockpit and a knob marked THROTTLE DAMPER is to the rear and outboard of the quadrant.

13. **Engine starting system**

(a) Starting is by a turbo-starter carrying six cartridges, two of which are fired simultaneously for each start.

(b) The ENGINE STARTER MASTER switch (68) completes the circuit to the igniter switch, starter switch, and booster-pumps. It should be ON for starting and at all times when the engine is running.

(c) The IGNITER switch (69) completes the circuit to the igniter plugs. The switch should be ON for starting, and at all times when the engine is running. A circuit breaker (70) is fitted adjacent to the switch and should normally be in.

(d) The STARTER switch (67) initiates the automatic starting sequence, controls the throttle by-pass, energizes the igniter plugs and automatically indexes and fires the starter cartridges.

14. **Relighting pushbutton**

The igniter plugs are used to restart the engine in flight, providing the IGNITER switch is on, by pressing the relighting pushbutton in the end of the H.P. cock control.

15. **Engine fire-extinguisher**

(a) A single fire-extinguisher bottle is carried in the engine accessory bay; this discharges only into the accessory bay. Twelve automatic resetting thermal switches are situated in the vicinity of the engine.

(b) An engine fire warning light (51) is inset in the centre of the yellow and black extinguisher pushbutton. The fire extinguisher can be operated irrespective of the position of the battery isolating switch.

(c) Serviceability of the light can be tested by *pulling* the extinguisher pushbutton.

MAIN SERVICES

16. **Electrical system (24 volts)**

(a) *D.C. supply*

Two paralleled engine-driven generators on a common drive shaft supply the whole of the aircraft electrical system and charge two 12-volt 25 amp. aircraft batteries connected in series giving an output of 24 volts. Two generator failure warning lights (46 and 47), on top of the instrument panel, indicate whenever the generators are not supplying power.

(b) *Batteries control*

A battery isolating switch (88), on the cockpit starboard shelf, when set to GROUND, isolates the batteries from the whole of the electrical system except the fire-extinguisher. It should be thus set when using external supply for starting, or when it is desired to isolate the batteries in flight. At all other times it should be set to FLIGHT.

(c) *Circuit breakers*

Circuit breakers (70) (84) (85) (86) (87) (97) and at (100) are on the starboard side of the cockpit. All circuit breakers should be checked in before flight and at intervals during flight. Any circuit breaker which has tripped due to a temporary overload should be reset.

(d) *A.C. supply*

(i) A three-phase, 400 c.p.s. 115V supply for the Artificial Horizon and Mk. 4F. compass is provided by one of two inverters each protected by circuit

breakers (84), and mounted one above the other on the port side of the engine accessories bay. The top inverter is the one normally used and is switched on by the ENGINE STARTER MASTER switch (68). If, however, the output from that inverter drops below 100V a torque switch operates and switches on the lower, or standby, inverter and switches off the top inverter. No indication is given that the change-over has taken place. When Mod. N590 is incorporated changeover is indicated by a magnetic indicator.

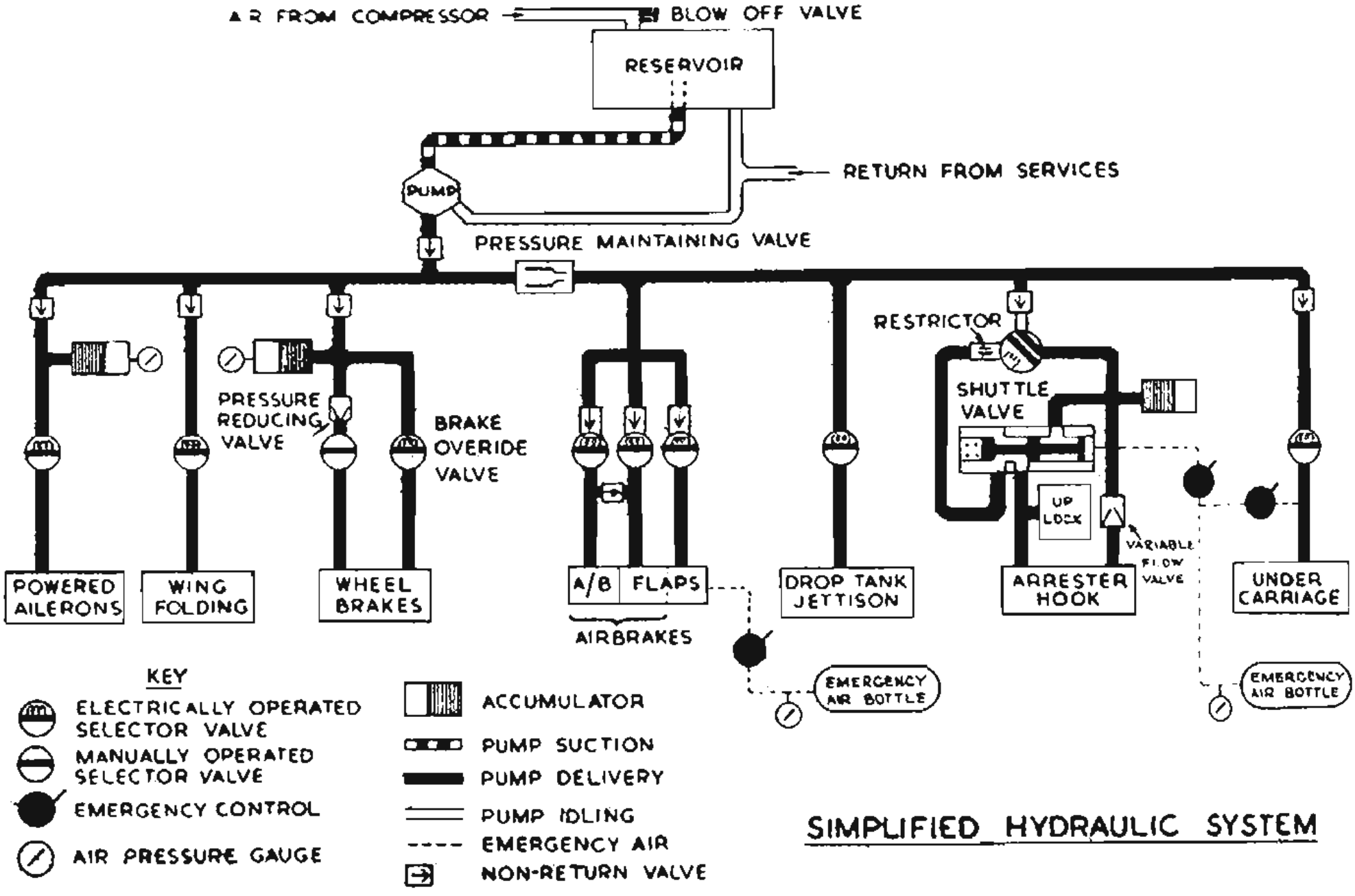
(ii) Inverter STOP-RESET pushbuttons (58) are on the starboard side of the instrument panel. When the top (STOP) button is pressed the D.C. supply to the top inverter is cut off and when the bottom (RESET) button is pressed the D.C. supply is switched from the "run" to the standby inverter.

NOTE.—For test purposes the standby inverter may be run by pushing the bottom (RESET) pushbutton while the ENGINE STARTER MASTER switch is off. On completion of the test the top button should be pressed.

17. **Hydraulic system**

(a) (i) Hydraulic pressure is provided by an engine-driven pump and fluid is taken from a reservoir stack-pipe. It is delivered to the power circuit at 2,050 lb./sq. in. for the operation of the following services:—

Electro-hydraulically	*Manual-hydraulically*
Airbrakes	Wheel-brakes
Arrester hook	
Flaps	
Drop-tank jettisoning	
Undercarriage	
Wing-folding	
Powered ailerons	



SIMPLIFIED HYDRAULIC SYSTEM

(ii) When the power circuit is fully charged, fluid is passed, via an engine pump cut-out and an idling circuit, back to the reservoir. A red warning light adjacent to the G.45 camera aperture switch (53) indicates if the pressure in this circuit falls below 900 lb./sq. in.

(b) No hydraulic pressure gauge is fitted, but an indication of the pressure available may be obtained from the reading of the wheel brakes accumulator air pressure gauge. This accumulator is charged initially to 1,050 lb./sq. in. with compressed air. After starting, as hydraulic pressure is increased above this figure, the air in the accumulator will be further compressed giving increasing gauge readings up to approximately 2,050 lb./sq. in. (When Mod. N.246 is incorporated a triple pressure gauge is fitted in lieu.)

(c) Hydraulic accumulators are incorporated in the wheel-brake, arrester hook and aileron power circuits.

(d) Two air bottles are fitted, one for the emergency operation of the flaps (see para. 92(b)), the other for the undercarriage and arrester hook (see paras. 92(a) and 92(c)).

POWERED FLYING CONTROLS AND TRIMMERS

18. **Aileron operation**

(a) *In Power*

The ailerons are power-operated, the power being supplied by hydraulic oil under pressure from the aircraft hydraulic system. A hydrobooster consisting of a valve and jack body and a piston rod is fitted close to each control surface. The control column is connected direct to the valve control rod so that, depending on the direction of movement of the control column, the valve opens to admit pressure oil to one side of the jack piston and at the same time, the other side is opened to "return". The piston rod is anchored to the aircraft structure by means of a spring-loaded hydraulically operated pawl. The jack body is directly connected to one end of the

control surface. When the pawl is in position and hydraulic pressure is fed from the valve to one side of the jack piston, the jack body moves relative to the piston and deflects the control surface. When control column movement ceases, the valve closes causing a hydraulic lock which prohibits further movement of the jack body and control surface.

(b) *In Manual*

(i) Manual operation of the controls may be selected deliberately by operating a switch (89) in the cockpit (see para. 19) provided that electrical power is available, or it will happen automatically if hydraulic pressure drops below 150 lb./sq. in.

(ii) When operating in Manual, control surface movements are achieved by the control column pushing the valve rod against its stop and then pushing manually the valve, the jack body and the piston rod to obtain control surface movement. The controls are heavy in Manual, but to avoid excessively high stick forces the spring-loaded hydraulically-operated pawls automatically disengage and release the anchored jack piston rod, allowing it to slide freely with the movement of the jack body.

(c) *Hydraulic power reserve*

An accumulator is fitted in the aileron circuit to provide a reserve of power if the main hydraulic supply fails. This reserve may be sufficient for about 5-10 cycles of aileron operation before the controls revert automatically to Manual, but even if no control movement is made, accumulator pressure will not be maintained for a long period due to seepage through the hydraulic components. With some types of hydraulic failure immediate reversion to Manual will result.

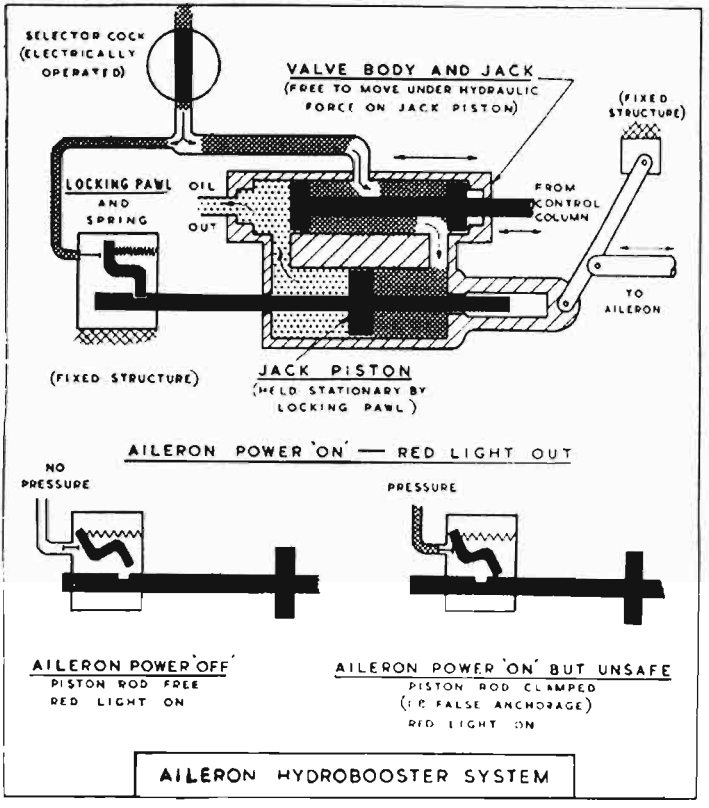
19. **Aileron control switch and indicators**

(a) A switch (89) marked POWERED AILERON CONTROLS OFF is on the starboard shelf and controls elec-

trically the hydraulic cock for the aileron circuit. When the engine is running and the switch is selected ON, hydraulic pressure is fed to the circuit and to the pawls which engage in the jack piston rods.

(b) A warning light (91), mounted beside the switch, comes on when either or both pawls are disengaged or incorrectly engaged and goes out when the locking pawls are correctly engaged. When Mod. N.434 is incorporated a magnetic indicator is fitted in lieu of the light.

(c) A red warning light (see para. 17a (ii)) is fitted in the cockpit to warn the pilot if hydraulic pressure falls below 900 lb./sq. in.



AILERON HYDROBOOSTER SYSTEM

20. **Aileron feel and trim**

(a) The piston rods are anchored to the aircraft structure, the airloads are resisted entirely by the hydraulic jack effort, and no load is fed back to the control column. To provide control feel, a spring is fitted in the control circuit and gives an artificial stick force which is proportional to aileron deflection but not to airspeed.

(b) A trim tab operated by an actuator is fitted to the port aileron. It is controlled by lateral movement of the rudder/aileron trim control (2) and is intended for use only when flying in Manual. A guard is placed round the control to prevent its inadvertent use when in power. Trim is recorded on the combined aileron/rudder trim indicator (1).

(c) With the introduction of Mod. N.329 an AILERON POWER/AILERON MANUAL change-over switch (92) is provided on the starboard shelf. When this switch is at AILERON POWER the aileron trim control (2) can be used to trim the spring feel unit and the feel unit trim is shown on the trim indicator (1). When this switch is at AILERON MANUAL the aileron trim control is used to operate the trim tab as in (b) above and the position of the tab is shown on the indicator. When the switch (92) is fitted, it must always be at AILERON POWER when the powered ailerons are in use and at AILERON MANUAL when manual aileron is being used.

21. **Engaging aileron power on the ground**

When the wings are spread and with hydraulic and electrical power available the selector switch should be set to ON and the control column moved to engage the power controls locking pawls. If, as is likely, the locking pawls are not opposite their slots, they clamp on the side of the piston rods. Considerable force is then required to slide the piston rods and engage the pawls in the slots. When the pawls are correctly engaged the control column can be moved freely over its full travel in all directions, and is felt to come up against positive stops at the extreme of its movement. The aileron power warning light should then go out, or the indicator go black.

22. **Re-engaging aileron power in flight**

When a re-selection to Power is made in the air, it is possible that the locking pawls will not engage in the slots on the piston rods, but merely clamp on the side of the rods giving false anchorage. False anchorages can be caused by the pistons "creeping" to full travel during a lengthy period of Manual flying, or when the ailerons are deflected appreciably either by the control column or by the presence of aileron up or down float when selecting Power ON or OFF. False anchorages can give two types of restriction.

(a) *One-way restriction*—See para. 70(f)

This usually occurs as a result of re-selecting power with the ailerons deflected, e.g., when initiating a turn. The locking pawls clamp on the side of the piston rods in opposite senses relative to the slots, e.g., one rod extended, the other retracted. There will be apparent power operated movement in one direction due to the clamping of the pawls on the rods. Movement of the control column in the other direction is restricted since power assistance is not available and not only has the friction clamp of both pawls to be overcome but the ailerons have to be deflected manually. This type of restriction can also occur as a result of having one pawl correctly engaged and one pawl out of engagement. Correct engagement of the pawls can be obtained by applying full aileron in the direction of unrestricted travel, thereby demanding a force greater than that which can be held by pawl friction, thus causing the piston rods to slide.

(b) *Both ways restriction* See para. 70(f)

This usually occurs as a result of re-selecting Power ON, with the ailerons floating up or down, e.g., when easing out of a dive. The pawls will grip the piston rods in the same sense relative to their slots, e.g., both rods extended or both retracted, giving complete jamming of the control column in the neutral position. Movement of the control column in either direction is restricted by the friction clamp of one pawl and the ailerons having to be deflected manually.

23. **Rudder and elevator trim controls**

(a) The rudder trim tab is actuated electrically by rotary selection on the common rudder/aileron trim selector (2) and the position of the tab is indicated by the combined indicator (1) forward of the selector.

(b) The elevator trim tabs are actuated manually by the large handwheel (6) on the port shelf. A visual indicator is positioned outboard of the wheel.

24. **Flying controls locking gear**

(a) *Internal locking*

This gear is intended for use only when the aircraft is parked in light wind conditions, as no positive lock is applied to the ailerons. It should be fitted as follows:—

(i) Lower the seat fully.

(ii) Attach the clip below the base of the control column handgrip.

(iii) Hook the shorter cables through the holes in the outer side plates of the rudder bars.

(iv) Hook the longer pair of cables through the holes in the seat.

(v) Tension the cables by raising the seat and adjusting the rudder pedals.

(b) *External locking*

Special clamps are provided and should be used at all times when the aircraft is parked in gusty weather. The clamps must always be removed before folding the wings, before removing the internal locks and before selecting the ailerons to power.

25. **Undercarriage control**

(a) The undercarriage selector UP (shielded) and DOWN pushbuttons (36) are on the instrument panel forward of

the throttle. When the requisite pushbutton is pressed the hydraulic selector valve is operated electrically and raising or lowering is performed hydraulically.

(b) The yellow and black striped lever (21) for the operation of the undercarriage emergency system is the central one of three situated forward of the throttle quadrant.

26. Undercarriage position indicator

(a) A standard indicator (35) is fitted on the outboard side of the selector pushbuttons. The nosewheel light shows red if the undercarriage UP button is pressed when the aircraft is on the ground. In this event the engine should not be started as a build-up of hydraulic pressure would cause the undercarriage to collapse.

(b) A single red light (38) above the selector pushbuttons indicates whenever the throttle is less than one-third open and the undercarriage is not locked down.

27. Undercarriage emergency operation

(a) If the normal method of lowering the undercarriage fails, either through an electric or hydraulic fault, it may be lowered by compressed air from an emergency air bottle. The available air pressure is shown on a gauge (10).

(b) To operate the system lift the emergency control lever (21) pushing it forward and down. It will operate irrespective of the position of the normal selector, but if the normal selector is left in the up position the nosewheel red light will remain on. Undercarriage DOWN should therefore be selected in order to check that the nosewheel is in fact locked down.

(c) The undercarriage may be retracted on the ground by pressing the UP selector pushbutton. This is inoperative if the undercarriage emergency system has been used.

28. **Flaps control and position indicator**

(a) The wing flaps are hydraulically operated and are controlled by a lever (23) on the cockpit port shelf inboard of the throttle control. The quadrant is marked UP—TAKE-OFF—LAND, each marked position being gated. No positions other than those gated can be selected.

(b) The flaps position indicator (37) is on the port instrument panel.

29. **Flaps emergency operation**

The flaps may be lowered to the fully down position only, irrespective of the position of the normal selector, by lifting the emergency lever (22) and pushing it forward and down. A pressure gauge (7) shows the air pressure available in the emergency air bottle.

30. **Airbrakes control**

(a) The airbrakes consist of trailing edge flaps, the lower surfaces being the landing flaps. They are controlled electro-hydraulically by a small lever (16) on the throttle control. Pressing this lever aft opens the airbrakes, the upper surface to 20° and the lower to 30°, provided that the flaps are fully up. Releasing it returns them to the closed position. If it is desired to retain the airbrakes in the open position the control should be pressed further aft when a catch will engage. This catch must be tripped in order to close the airbrakes.

(b) If the flaps are lowered when the airbrakes are already out, the airbrakes will retract. Should the flaps then be raised with the airbrakes still selected out, the airbrakes will again extend.

(c) Movement of the airbrakes is indicated on the flaps position indicator.

31. **Arrester hook control**

(a) The two-position UP-DOWN switch (41) is on the port side of the instrument panel. When DOWN is selected

the main hydraulic power causes a hydraulic accumulator to be brought into circuit. Pressure from the accumulator releases the hook up-lock and lowers the hook. When UP is selected the main hydraulic supply provides power for raising the hook and recharging the accumulator.

(b) A green light (40) adjacent to the switch indicates when the hook is fully lowered.

(c) The navigation lights come on whenever the hook is lowered and the undercarriage is down and locked.

32. **Arrester hook emergency control**

(a) The control for emergency lowering is on the port shelf. Lifting the lever (20) and pushing it forward and down causes air from the undercarriage emergency air bottle to bring the hydraulic accumulator into circuit. The hook up-lock is then released by the accumulator and the hook is lowered.

(b) Once the emergency system has been used to lower the hook it will not be possible to raise it again.

(c) Should the hydraulic accumulator fail it will not be possible to lower the hook.

33. **Arrester hook training switch**

When the training switch adjacent to the arrester hook control is operated, it switches on the navigation and hook indicator lights without lowering the hook.

34. **Wheel-brakes control**

(a) The wheel-brakes are hydraulically operated by means of the lever on the control column and a differential relay controlled by the rudder bar.

(b) The available pressure in the system is shown on the accumulator air pressure gauge. This pressure is reduced to 1,000 lb./sq. in at each wheel-brake. A triple pressure

gauge (9) is fitted on Mks. 3, 4, 5 and 6 aircraft only when Mod. N.246 is incorporated. It is fitted to the cockpit port wall, the accumulator gauge being deleted.

(c) In the event of hydraulic pump failure, which may be indicated by the red light, the accumulator, if fully charged with hydraulic fluid to a pressure of 2,050 lb./sq. in., will provide sufficient pressure for the landing run, but leaves little in hand for subsequent taxying. When the accumulator is exhausted of fluid the gauge should read 1,050 lb./sq. in., indicating that the brakes are inoperative. When a triple pressure gauge is fitted the centre needle is in lieu of the existing gauge. On either gauge, any reading below 1,300 lb./sq. in. will not allow more than one application of the brakes.

(d) A switch (below 19) on the port side can be used to allow the full hydraulic pressure of 2,050 lb./sq. in. to by-pass the brakes pressure reducing valve. This operation locks the wheels solid.

35. **Wing folding control**

(a) The two-position FOLD-SPREAD switch (5) is inboard (outboard on early aircraft) of the elevator trim handwheel. When the switch is set to FOLD the wing locking pins are retracted. When they are fully back, sequence valves operate to fold the wings. Only when the aircraft is on the ground, with the weight on the undercarriage and the flaps and airbrakes retracted, is the switch operative.

(b) When the switch is set to SPREAD the reverse action takes place and two red warning lights on the port light deflector shield, visible to both pilot and ground crew come on. When the wing locking pins are fully home they operate micro switches to break the circuit to the warning lights, and in addition bring into circuit the wing flap control, enabling flap to be selected.

NOTE.—When Mod. N519 is incorporated the electrical warning light system is deleted and a notice to this effect is secured in the cockpit.

(c) Two mechanical indicators, one at each wing-fold position on the top surface of each inner wing, rise above the wing surface when the locks are withdrawn and lie flush with the surface when the wings are spread and locked. In addition two spring-loaded plungers, one at each wing-fold position on the under surface of the wing indicate, if they can be depressed, that the locking pins are not fully home.

COCKPIT EQUIPMENT

36. **Flight instruments**

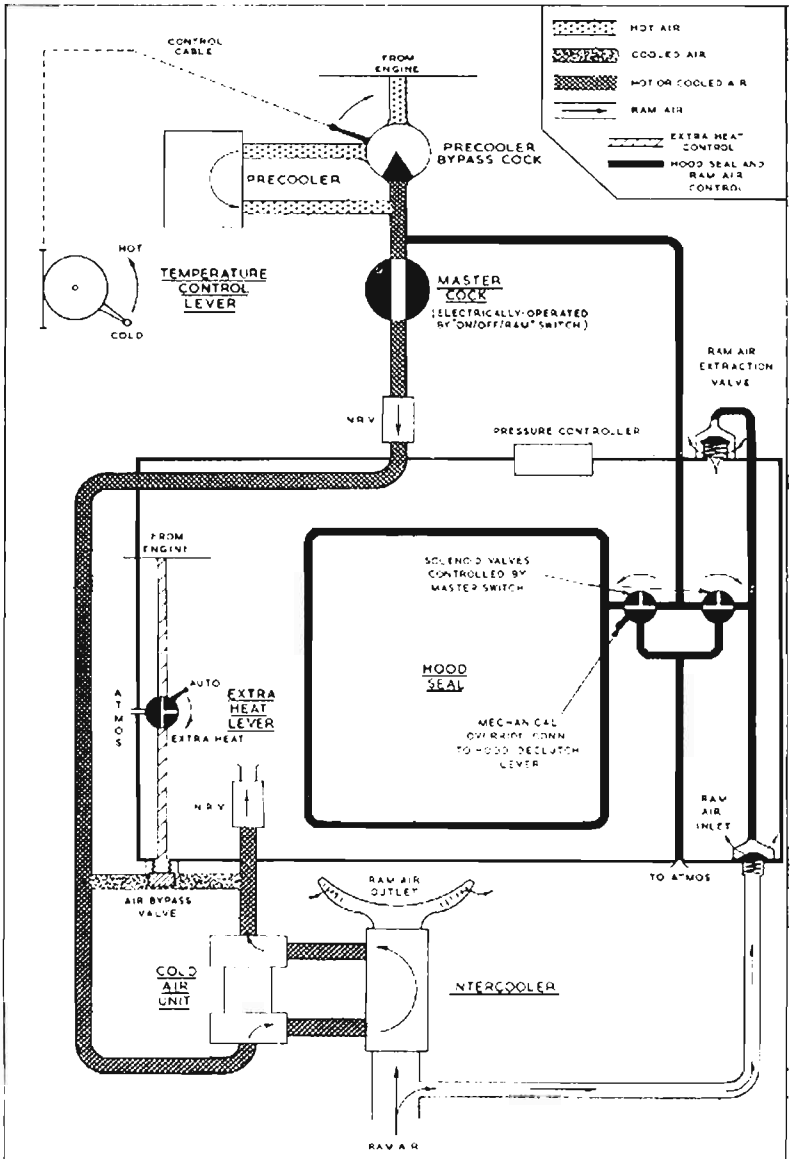
(a) The usual flight instruments are fitted, an Altimeter, A.S.I., V.S.I., Artificial horizon, Mk. 4F compass, and a Turn-and-slip indicator being mounted on the centre panel. To the left of the panel is a Machmeter and an Accelerometer and above that is a deck-landing A.S.I. (43). A type E2 standby compass (50) is under a shield at the top of the windscreen, starboard side.

(b) (i) The artificial horizon and Mk. 4F compass, operated by A.C., are switched on when the ENGINE STARTER MASTER switch (68) is on, provided the flight instruments circuit breakers (84) are in (see para. 16(d)).

(ii) The turn-and-slip indicator is operated by the D.C. supply. A warning indicator in the face of the instrument shows OFF when power is off. In the event of total power failure Mod. N358 provides an alternate D.C. supply from an alkaline battery. A guarded changeover switch (62) is located above the instrument.

37. **Hood operation**

(a) The hood is normally actuated electrically by means of a three-position OPEN-OFF-SHUT switch (13) on the port wall. Its circuit breaker (86) is on the starboard shelf. The hood seal is automatically inflated when the hood is closed and automatically deflated when OPEN



SIMPLIFIED COCKPIT PRESSURE DIAGRAM

is selected. After selecting OPEN the hood lock release lever (12) must be held hard down until the hood has started to open. There will be a delay of a few seconds before it commences to move to allow the seal to deflate.

(b) When on the ground the DECLUTCH control (14), which is above the operating switch, should be pushed down to lock the switch in the OFF position. This declutches the actuator enabling the hood to be manually opened (after first depressing the locking bar) or closed.

(c) The hood is held in the closed position by a spring-loaded pawl at the forward port end of the hood rail. The pawl may be freed from inside by pushing down a lever below the switch or from outside by depressing a plunger on the fuselage port side.

(d) An internal jettison control (42) is fitted above the port side of the instrument panel. An external jettison control is situated forward of the leading edge on the fuselage port side.

38. Entry to aircraft

Two footsteps are inset on the fuselage port side. They are hinged along their bottom sides and when the adjacent pushbuttons are pressed the footsteps are lowered. When not required they may be secured flush with the fuselage skin by spring-loaded catches.

39. Cockpit pressurisation, heating and ventilation

NOTE.—On Mk.2 aircraft the pressurisation system is blanked off and its use is prohibited. The cockpit pressure warning horn should always be switched OFF in these aircraft otherwise it will come on and stay on at heights above 9,000 ft.

(a) The controls consist of a master ON-OFF-RAM switch (73) on the starboard wall, and a heat control (31) on the side of the port shelf with, on some aircraft, an adjacent emergency extra heat control. A circuit-breaker

(87) is on the starboard shelf. A minimum time of two seconds must elapse between each operation of the master switch, otherwise there is a risk of the system becoming out of phase with the switch.

(b) When the master switch is ON and the heat control is fully down (cold air position), air from the engine compressor is first passed through a precooler and a refrigeration unit and finally to the cockpit. As the heating control is moved upwards the refrigerator is increasingly by-passed, thus permitting adjustment of cabin temperature. Should the heat so obtained still be insufficient, the extra heat cock should be pulled up. This by-passes the entire cooling unit.

(c) When the master switch is at RAM an air extractor valve opens and air is fed into the cockpit via a duct in the fuselage nose and the cabin ram air entry valve. In the event of failure of the electrical system the extractor valve will close automatically.

(d) When the master switch is set to OFF, both the air supply from the engine compressor and from the ram air inlet are cut off and there is no air entering the cockpit.

(e) Operation of the engine fire-extinguisher causes the pressurising system to be turned off automatically and at the same time opens the extractor.

(f) A cockpit altimeter (56) shows the altitude corresponding to the cockpit pressure. In addition a warning horn sounds whenever the pressure falls below a predetermined minimum. An override switch (79) on the starboard panel can be used to switch off the horn should it become an annoyance if the pressurising system fails. Both the cockpit altimeter and the horn should indicate in accordance with the following table.

Actual altitude (ft.)	Approx. equivalent cockpit altitude (ft.)	Approx. cockpit altitude at which horn sounds (ft.)
20,000	13,000	13,750
30,000	16,500	18,800
40,000	22,500	24,000

40. Windscreen de-icing and de-misting

(a) A de-icing system is provided for the centre panel only. It consists of a fluid tank, pump and spray unit. The pump (61) is fitted on the starboard side of the instrument panel and the external spray unit is below the base of the windscreen centre panel.

(b) A silica-gel air drier is fitted in the nose of the aircraft for de-misting the windscreen centre panel.

(c) When Mod. N255 is incorporated, a de-misting cock (59) is fitted at the forward end of the starboard shelf. Marked DEMIST—ON/OFF, it ensures, when ON, that all the hot air from the pressurisation system is directed on to the windscreen. The two switches (52) above the fuel gauges are inoperative.

41. Cockpit lighting

(a) *Ultra-violet and red lamps*

These lamps are controlled by three on/off dimmer switches on the cockpit starboard shelf. A master switch (76) is fitted to control the forward red lamps only.

(b) *Emergency lighting*

A single emergency lamp is fitted, powered by a separate 2-volt battery and controlled by an on-off switch (77).

42. External lighting

(a) *Navigation lights*

These are controlled by a DIM/OFF & MORSE/BRIGHT switch and an adjacent MORSE signalling switch (94) on the cockpit starboard shelf. The lights also come on at full brilliance whenever the undercarriage is down and locked and the arrester hook is lowered, or the training switch is operated, irrespective of the position of the selector switch.

(b) *Identification lights*

The controlling MORSE/OFF/ON switch (96) and MORSE signalling switch are mounted on the starboard shelf.

43. **Ejection seat Mk. 2D**

WARNING.—The firing handle must always be locked against the possibility of accidental withdrawal whenever the aircraft is on the ground. The fabric safety strap should be passed through the handle and secured by a spring safety pin. It is the pilot's responsibility to lock the handle after landing and to ensure that the pin is removed and stowed prior to take-off. All personnel must ensure that the firing handle is locked before entering the cockpit.

(a) A Mk. 2D pilot ejection seat is fitted incorporating a type ZF harness, headrest, two retractable thigh guards, footrests, parachute container and a seat well for the K dinghy, type J pack and emergency oxygen bottle. Full automatic facilities are provided to separate the pilot from the seat and to open his parachute after ejection.

(b) Both thigh guards are retained in the retracted position by locking pins. Manual release of the thigh guards is by pulling upwards a control on the port side of the seat pan; automatic release is by operating the canopy jettison control. When either the manual or automatic release system is operated both thigh guards spring to the raised position with considerable force. The thigh guards cannot be retracted unless the automatic release sear is in position.

(c) The seat may be adjusted for height by a lever on the starboard side of the seat; the harness release lever is also on the starboard side.

(d) The ejection gun is fired by pulling the handle immediately above the headrest.

(e) All leads incorporate quick releases which are automatically broken on ejection.

(f) After ejection at heights of 10,000 ft. and below a barostat causes the automatic cycle to operate. After 5 seconds (3 seconds if Mod. 187 is incorporated) the safety harness is released as are the face screen, firing handle and headrest pad. An apron attached to the seat drogue then pitches the pilot head first out of the seat, at the same time opening his parachute.

(g) For use if the automatic system fails, a manual override D-ring is fitted on top of the ripcord D-ring. When the override D-ring is pulled it isolates the automatic device.

44. **Pressure head heater and G45 camera master switches**

The heater elements in the pressure head are controlled by an ON/OFF switch (80) on the starboard shelf which is linked to the camera master switch.

45. **Oxygen system**

(a) Oxygen is carried in two 750 litre cylinders mounted in the starboard stub wing. From the cylinders oxygen passes through a pressure relief valve and thence to a Mk. 11 regulator or, if Mod. N38 is embodied, a Mk. 17 pressure demand regulator.

(b) *Mk. 11 regulator*

From the regulator, oxygen passes via a 4-way economiser cut-out to the Mk. 4 economiser and thence to the pilot's mask. The economiser cut-out on the cockpit starboard side is normally pre-set with the economiser in circuit, but when the use of pressure breathing equipment is required the cut-out must be set to P.B., so that the pressure breathing waistcoat becomes the economiser.

(c) *Mk. 17 regulator*

(i) A contents gauge (60) is mounted on the starboard shelf. The regulator (63), below the flight panel,

consists of an ON/OFF valve which controls the flow of oxygen, an air inlet NORMAL-100% OXYGEN switch, an emergency three-position switch and a combined flow and blinker unit.

(ii) When the ON/OFF valve is on and the inlet switch is at NORMAL, an air/oxygen mixture is fed to the pilot's mask up to a height at which 100% oxygen is automatically delivered. When the inlet switch is at 100% OXYGEN, no air is added irrespective of the height. This position should be selected if any symptoms of anoxia are present. The emergency switch when moved to either right or left admits oxygen under greater pressure. Normally it should be central, but should be offset if cabin pressure failure occurs.

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

(d) *Emergency system*

An emergency oxygen bottle is carried in the dinghy pack and is automatically brought into action upon ejection, provided the safety pin has been withdrawn. A manual operating control (95) is situated on the cockpit floor by the starboard side of the seat.

46. **Navigation equipment**

A map case is provided on the side of the starboard shelf and a chartboard stowage on the side of the port shelf.

OPERATIONAL CONTROLS

47. **Radio controls**

(a) *VHF-TR. 1934/1935 radio relay*

The control unit (78) is on the cockpit starboard wall. The press-to-transmit pushbutton is on the end of the throttle lever twist grip.

(b) *ZBX-ARI. 5307*

The control box (82) and mixer box (81) are on the cockpit starboard wall.

(c) *ARI. 18049*

The control unit (83) is on the cockpit starboard wall and the indicator (57) is on the starboard side of the instrument panel.

48. A.R.I. 5848—IFF

When IFF is fitted D.C., power to the inverter is via the IFF master switch (11) on the cockpit port wall. The controller is mounted beneath the hood controls.

49. Gyro gunsight Mk. 4E

(a) The G.G.S. is mounted on a retractable mounting above the centre of the instrument panel. The linked G.G.S. master and retraction switches (45) are on the left of the sight. The G.G.S. circuit breaker (85) is on the starboard shelf.

(b) The retraction motor circuit is coupled to the hood jettison mechanism so that the G.G.S. will automatically be retracted when the hood is jettisoned, if electrical power is available.

(c) In the event of electrical failure the G.G.S. may be retracted manually by striking the knob (49), on the right of the sight, a hard blow.

(d) The ranging control is incorporated in the throttle lever twist grip and the selector/dimmer control (33) is on the cockpit port side.

50. G45 camera and camera recorder

(a) Providing the master switch (80) is on, the cine camera and camera recorder are operated when any of the firing

switches on the control column are pressed, but a push-button (65) is provided so that the cameras may be operated independently. To prevent electrical failure of the sight the recorder camera should not be plugged in or unplugged while the sight is in the up position.

(b) The CLOUDY/SUNNY aperture switch (53) is above the instrument panel.

51. **Guns/R.P. firing**

(a) Gun firing is controlled by the switch on the forward face of the control column. The armament master switch (17) is on the cockpit port wall.

(b) On FB3 & 5 and FGA4 & 6 aircraft a G.G.S. GUNS/R.P. switch (18) and an R.P. selector switch (19) are adjacent to the armament master switch. A rocket battery switch may be fitted but this is inoperative.

(c) The guns may be made electrically safe on the ground by withdrawing the safety plugs which are provided with red pennants and located one in each gun bay.

(d) The R.P. firing button (64) is on top of the control column.

52. **RATOG**

(a) The RATO master switch (90) is on the cockpit starboard shelf and the firing pushbutton (39) is adjacent to the undercarriage UP pushbutton.

(b) The RATO carriers are automatically jettisoned when the undercarriage is selected UP.

53. **P.R. cameras**

The camera controller and the oblique/vertical control switch (4) are mounted at the aft end of the cockpit port shelf.

54. **Bombing equipment**

(a) On Mks. 3, 4, 5 and 6 aircraft a bomb selector and fusing switch-panel is fitted on the side of the port console inboard of the throttle quadrant. A warning light (30) comes on when the armament master switch is set to GUNS AND BOMBS if the bombs are not fused. Bomb release is effected by use of the R.P. firing button (64) on the control column.

(b) In Mks. 3 & 5 aircraft, bombs are carried on inner pylons which are capable of being jettisoned. The stores themselves are jettisoned by means of a guarded, caged switch, located at the after end of the BOMB CONTROL PANEL and marked JETTISON-ROCKET BATTERY/BOMBS. The rocket-battery is inoperative and the cage should be selected to BOMBS. If it is desired to jettison the pylon complete, it is accomplished by a switch (93) on the starboard panel.

(c) In Mks. 4 & 6 aircraft, bombs may be carried on both the inner and fixed outer pylons. The stores themselves are jettisoned by two pushbuttons (27) on the BOMB CONTROL PANEL, marked JETTISON INNER and JETTISON OUTER. As with the Mks. 3 & 5 aircraft the inner pylon complete is jettisoned by switch (93).

55. **Anti-G equipment**

Compressed air, from an air bottle in the fuselage, is fed to the anti-g suit, via an anti-g valve and an ON/OFF control (32), which is mounted forward of the bomb control panel. For test purposes the suit may be inflated by depressing the pushbutton forward of the ON/OFF control.

PART II

LIMITATIONS

56. **Engine limitations—Nene Mks. 101 and 103**

		Nene 101		Nene 103	
Power Rating	Time Limit	Max. R.p.m.	Max. J.p.t.°C.	Max. R.p.m.	Max. J.p.t.°C.
Take-off and Operational necessity	15 mins. combined	12,500 ±100	735 —	12,700 ±100	750
Intermediate	30 mins.	12,200	690	12,400	725
Max. continuous	Unrestricted	11,800	635	12,000	670
Ground idling	Unrestricted	2,500 ±100	550	2,500 ±100	550

Oil pressures (both marks)

At max. continuous r.p.m.:—

Normal ... ... 40 lb./sq. in.

Minimum ... ... 20 lb./sq. in.

Minimum at idling r.p.m. ... ... 3 lb./sq. in.

57. **Flying limitations**

(a) (i) *Maximum speeds*:—

Clean aircraft	520 K. (No mach limitations, but see para. 75.)
With drop tanks	
2 x 88 gall. steel tanks (Mod. N1001)	440 K *or* 0.7M up to 10,000 ft. increasing by 0.01M per 5,000 ft. up to 0.74M at 30,000 ft. and above.
2 x 75 gall. plastic tanks (Mod. N1015)	480 K *or* 0.82M below 15,000 ft., 0.83M above 15,000 ft. *or* 0.81M at all heights with ailerons in Manual.
Jettison—	
For steel tanks	440 K (200 K if Mods. N271 and N357 are not incorporated.)
For plastic tanks	440 K *or* 0.7M.
With hood open	160 K } These speeds also
With U/C lowered	200 K } apply to the opera-
With full flap	170 K } tion of the service.

(ii) *G limitations*

The following accelerometer readings must not be exceeded.

Clean or with empty drop tanks +7.3G	(6.6G during application of aileron)
With stores	+5.4G

(b) *Carriage and release of armament stores-limiting speeds*

Bombs*:-

Carriage	520 K or 0.8M.
Release—Airbrakes OUT	430 K or 0.8M. Max. angle of dive 90°
Release—Airbrakes IN	475 K or 0.8M. Max. angle of dive 45°

Practice bomb carrier release	150 K
R.P.s** carriage and release	480 K or 0.8M. Max. angle of dive 80°
Target towing	240 K

*When carrying 1,000 lb. bombs MC Mk. 6 with No. 100 Mk. 5 tails, flap extension is limited to 49°.

**When mixed loads of R.P.s and drop tanks are carried, speed limitation for drop tanks applies. R.P.s are not carried on F.B.3 & 5 aircraft.

(c) *Loading limitations*

Overload take-off	F2—15,100 lb. FB3 & 5—15,600 lb. FGA4 & 6—16,200 lb.
Target towing	14,800 lb.
Normal take-off and all forms of flight	13,600 lb.
Landing	12,100 lb.
C.G. limits	41 ins. to 45 ins. aft of datum with undercarriage down.

(d) *Special limitations*

(i) Flight manœuvres involving negative G are prohibited unless Mods. Nene 327 and Sea Hawk N119 are incorporated. Provision is then made for 15-second (max.) supply of oil and fuel under negative G conditions.

(ii) Irrespective of the modification state, flight manœuvres involving negative G are prohibited when less than 125 gallons (1,000 lb.) of fuel remain.

(iii) If Mods. N465 and either N307 or N452 are not incorporated, whenever possible r.p.m. must not be reduced below 10,000.

(iv) All aircraft are permitted to operate with a 30 ft. banner target using drag or snatch methods for launching, provided that Mods. N252 and N1035 are embodied, in temperature conditions ISA to ISA + 17°C. (See Part V.)

(v) Mk. F.2 and FB. Mks. 3 & 5 are restricted to a maximum height of 35,000 ft. if Mod. N253 (improved generator cooling) is not incorporated.

(vi) The aircraft are cleared for practice spinning up to 2 turns, when " clean " or with drop tanks fitted, and with ailerons in power or manual.

(vii) Use of RATOG is not permitted.

PART III
HANDLING

58. **Management of the fuel system**

NOTE.—1. *A check that the fuel balancer system is functioning correctly must be made as soon as possible after take-off.* If the correct fuel levels are not maintained (see sub-paragraph a (ii)), the aircraft will not be within its permitted c.g. limits and must be restricted to gentle manœuvres only. Excess fuel in the forward tanks (forward c.g.) will give higher elevator forces than normal and reduced elevator control at low speeds. Conversely, excess fuel in the rear tanks (aft c.g.) will lead to abnormally light elevator forces, tightening in turns, and self stalling tendencies under approach conditions.

2. There is no indication from the fuel gauge that the saddle tank is full as the gauge is worked only by the change in level of the rear tank of the rear group.

(a) *Control of the booster pumps*

(i) Under normal conditions of flight the booster-pump switch should be at NORMAL (forward) thus allowing draining of the tanks to be controlled by the automatic system. This ensures that the c.g. is maintained within the correct limits.

(ii) Fuel levels, ±10 gallons or ±100 lb. in any one tank level relative to the other, and according to the modification state, should indicate as follows:—

Gauge readings, in gallons			Gauge readings, in pounds		
Front tank	Rear tank		Front tank	Rear tank	
	Mod. 148	Mod. 205		Mod. 276	Mod. 298
175	175	150	1,400	1,450	1,300
150	115	110	1,200	875	1,040
100	65	55	1,000	650	850
50	25	20	800	460	690
			400	175	360

(iii) If:—

(1) The fuel gauges show greater differences than those in (ii) above, or

(2) The central light under the fuel pump red warning panel comes on:—

Set the booster-pumps switch aft to RELIGHT & EMERGENCY and maintain the correct fuel levels by operating the L.P. cocks, i.e. shutting off the tanks containing too little fuel.

(iv) When the drop tanks are in use, fuel may also be used from the rear tanks and their level may drop to 140 gallons (1,120 lb.). This is particularly likely under conditions of high fuel consumption, where the automatic transfer rate from the front tanks only may not be sufficient to cater for the full demands of the engine. When fuel transfer from the drop tanks to the front tanks is complete, the fuel levels should be restored automatically by the fuel balancing system.

(b) *Booster-pump failures*

(i) If, with the booster-pumps switch to NORMAL, the front and rear lights under the red warning panel come on (indicating a mechanical or an electrical fault in one pump), the other pump will automatic-

ally be switched off. The resultant reduction of fuel pressure will cause the fuel pressure warning light to come on, indicating that fuel is being fed to the engine by gravity and air pressure only. Should this be the case, proceed as follows:—

(1) Check the ENGINE STARTER MASTER switch is ON and the engine and booster-pump circuit breakers are in. If the circuit breakers have tripped, reset.

(2) If they cannot be reset, move the booster-pumps switch aft to RELIGHT & EMERGENCY, and then reset. If the pumps warning lights then go out, the fault is confirmed as an electrical one, and manual balancing should be resorted to as in (a) (iii) above.

(ii) If a booster-pump has actually failed, and RELIGHT & EMERGENCY has been selected, the front and rear lights under the red warning panel will come on at *half intensity* indicating that one pump only is now functioning. In this event, reduce height to below 20,000 ft. and then set the booster-pumps switch to OFF (central). Fuel will then be fed to the engine by gravity and air pressure only, and the fuel pressure warning light will remain on. The correct fuel levels should be maintained by operating the L.P. fuel cocks.

(iii) If a fuel gauge fails to read with the tank pumps switch set to RELIGHT & EMERGENCY, accurate manual balancing will not be possible, and the OFF position (central) should be selected, provided height is below 20,000 ft. The fuel will then drain equally from each tank group.

(c) *H.P. pump isolating valve and A.C.U.*

The H.P. pump isolating valve switch (71) should be set to ISOLATE (warning light (72) on) if there is an inexplicable drop in r.p.m. It may also be used as a safeguard against failure of the servo system during take-off. When the switch is at ISOLATE, throttle move-

ments must be made carefully as the A.C.U. is inoperative. Even when the A.C.U. is operative rapid opening of the throttle may lead to a high j.p.t. and jet-pipe resonance.

STARTING, TAXYING AND TAKE-OFF

59. External checks

NOTE.—1. *Fuel.* Check that the aircraft has been refuelled with the correct specific gravity fuel for which the engine is governed.

2. *Undercarriage.* The main undercarriage doors may droop from the closed position when the aircraft has been standing for some time. They should retract on starting the engine.

The outside of the aircraft should be systematically checked for obvious signs of damage, security of panels, *filler caps*, doors, undercarriage fairings, control surfaces, wing fold mechanism and drop tanks. The engine intakes should be free from debris, the jet pipes should be checked for wrinkling and the turbine blades for damage. The oleos should be checked for correct extension (main oleos $1\frac{3}{4}$ in.), the tyres for cuts and excessive wear, and the brake leads for damage. The pressure head cover, the undercarriage ground locks and the external locks for the control surfaces must be removed.

60. Checks before starting

NOTE.—1. The "off" position of unmarked switches is down or vertical.

2. Unless an external source of electric power is available, it is recommended that the last ten electrically-operated items mentioned in the check list below are not used until just before start up, or where applicable, until the engine is running and charging the battery adequately, i.e., between 5,500-6,500 r.p.m.

(a) Enter cockpit and check:—

Ejection seat	Safety pin fitted in safety strap.
Hood	Security, free from cracks
Emergency oxygen bottle	Pin removed.
Main oxygen supply	Connected to pipe on ejection seat.
Thigh guards	Stowed.
Emergency air bottles (10)	1,900 lb./sq. in. minimum.

Check automatic parachute and harness release as follows:—

The drogue static line pin fitted in its bracket. The time release gear static pin fitted in its bracket. All apron clips in position.

(b) Strap in, adjust rudder pedals and seat, make radio, oxygen and emergency oxygen connections; have seat safety pin removed and stowed, then check:—

All armament switches	Safe or off.
Undercarriage selector (36)	DOWN button in.
RATO master switch (90)	Covers on, switches vertical.
Tank or bomb jettison switch (93)	
Brakes	On.

Then work from left to right

L.P. cock levers (8)	Both ON.
H.P. cock lever (3)	OFF.
Heating controls (31)	As required.

Elevator trim control (6)	Check operation. Set as follows for take-off:— 1 div. nose down (flaps UP, clean). *or* Neutral (flaps at TAKE-OFF, clean). *or* 1 div. nose up (flaps at TAKE-OFF, full drop tanks).
Hood	If closed, switch (13) forward, clutch release (14) up. If open, switch aft, clutch release up.
Wing fold switch (5)	Corresponding to position of wings. (No indication of the position of the wing pins is given by the cockpit red warning lights *unless the switch is at* SPREAD and electrical power is available.)
Throttle (15)	Full and free movement then closed.
Airbrakes control (16)	Fully forward.
Flap control (23)	UP, fully forward.
Brakes override switch (below (19))	Down (off).
Arrester hook switch (41)	UP.
Arrester hook training switch	UP (off).
Hood jettison control (42)	In.
Fire warning light (51)	Out (PULL TO TEST).
Oxygen	*Mk. 11 regulator* Contents and delivery (set "HIGH" if going above 25,000 ft.). Emergency bottle supply connected. *Mk. 17 regulator* (63) 100% Flow. Blinker annunciating and oxygen reaching mask. Emergency bottle supply connected.

V.H.F. (78)	Select channels.
Cockpit pressure warning horn switch (79)	On, if pressure cockpit. Off if no pressure cockpit.
Booster-pumps switch (98)	OFF, circuit breakers (97 & 100) in.
Flight Inst., G.G.S. Hood and cockpit pressure circuit breakers (84, 85, 86 & 87)	In.

Switch the battery isolating switch (88) to FLIGHT if external supply is not connected (see para. 16 (b)).
Check:—

Undercarriage position indicator (35)	Three green lights, bulb changeover and day/night switches.
Flap indicator (37)	Corresponding to position of flaps (or airbrakes).
Hydraulic pressure failure warning light	On.
Fuel gauges (54, 55)	Reading.
Fuel pressure warning light (48)	On.
Generator warning lights (46, 47)	On.
H.P. fuel pump isolating valve switch (71)	NORMAL (Off). Light (72) out.
Cockpit pressurisation switch (73)	OFF.
Internal and external lighting	As required.
Inverter reset relay (58)	Press bottom button and check that standby inverter starts up and artificial horizon begins to erect. Then press top button.

61. Starting the engine

NOTE.—Economy must be practised when using power from the aircraft battery. The generator failure warning lights are difficult to see in bright daylight, and may not give the pilot immediate warning of failure. If the usual electrical services are ON, the battery, if 60% charged, has only sufficient power available for about 2 minutes when engine r.p.m. are below 6,000.

(a) Engine starter master switch (68)	On (up). Leave on after starting.
	Check main inverter cuts in.
	Check instruments start to erect.
Igniter switch (69)	On. Leave on after starting.
Booster-pumps switch (98)	NORMAL, L.P. fuel pressure warning light (48) out.
H.P. cock (3)	Check ignition aurally by pressing relight button and put cock to ON.

Trip starter switch for 1 second. There will be a delay of about 4 seconds before the cartridges fire.

(b) The cartridge starter should accelerate the engine to about 1,800 r.p.m. in 3 seconds. Light up then occurs and after a short delay the engine will continue to accelerate slowly to idling r.p.m. Watch the j.p.t. and if it exceeds 735° (except momentarily), or if there is excessive resonance, the engine must be stopped by closing the H.P. cock.

(c) If the engine does not light up, turn OFF the H.P. cock and switch off the igniter switch.

(d) (i) If a pair of cartridges fail to fire, switch off the igniter switch, and wait 15 seconds before attempting another start.

(ii) If the engine does not accelerate to about 1,500 r.p.m. on the starter alone, it is probable that one cartridge only has fired. Resonance and overheating will then occur, and if the j.p.t. exceeds 735° the engine must be stopped by closing the H.P. cock.

(iii) If both cartridges appear to fire, but the engine does not accelerate to more than about 1,000 r.p.m., a single blown safety disc should be suspected. The engine will not accelerate beyond this point, and to avoid excessive j.p.t. the start must be abandoned by closing the H.P. cock and switching off the igniter switch. If the safety discs on a pair of cartridges blow, the engine will not be turned over at all. Blown safety discs on one pair of cartridges will not affect ability to start on a further pair.

(e) (i) Do not attempt to start the engine while it is still turning as this may overspeed the starter.

(ii) Do not attempt to restart until all excess fuel has drained from the nacelle.

(iii) After three consecutive attempts to start, leave the starter for 10 minutes before reloading. Switch off igniter and engine starter master switches before reloading or investigating a fault in the starter.

(iv) If it is required to dry out the engine following a wet start, carry out the normal starting procedure but with the H.P. cock and the igniter switch off.

(v) If an external electrical supply has been used for starting, the battery isolating switch should be set to FLIGHT before the external battery and adaptor are disconnected. The external supply must remain ON the whole time it is plugged in. This is to prevent relay "chatter."

62. **Checks after starting**

Jet pipe temperature (66)	550°C max.
Fire warning lights (51, 44)	Out.
Engine idling r.p.m.	2,500 ± 100 (check oil pressure is 3 lb./sq. in min.).
Generator warning lights (46 & 47)	Out.

Aileron trim change-over switch (92) (if fitted)	AILERON MANUAL.
Aileron trimmer (2)	Check operation, set to neutral and lock.
Aileron trim change-over switch (92) (if fitted)	AILERON POWER.
Rudder trimmer (2)	Check operation, set to neutral.
Hydraulic pressure	1,900 lb./sq. in (min.) Warning light out. If wings are spread operate flaps and airbrakes.
Artificial horizon	Erect if necessary by fast-erection button.
Mk. 4F compass	Serviceability and synchronisation.

NOTE.—It is essential that the wings are spread before the Mk. 4F compass is checked with the E2 compass.

V.H.F. (78)	On and test.
Booster-pumps switch (98)	NORMAL, fuel pressure warning light (48) out.
Pressure head heater and camera master switch (80)	ON.
Z.B.X. (82)	Test and as required.
Ailerons power control switch (89)	Off, check that the ailerons are unobstructed throughout their full travel. Select ON, and move the control column laterally through its full travel both ways to engage the boosters. Check warning light (91) goes out and the stick will self-centre when released from a position 2 in. to one side of the central position. (The stick will not necessarily self-centre in manual).

NOTE.—1. Considerable force may be required to engage the pawls.

2. The wings must be spread.

63. Testing the engine and services

(a) At 9,000 r.p.m. check the H.P. pump isolating valve by switching to ISOLATE, when the warning light should come on. A rise in r.p.m. should occur if the valve is functioning correctly. Return the switch to NORMAL and note that the r.p.m. return to the original figure, and that the light goes out. Should there be no r.p.m. change during the test, the engine should be stopped and the cause investigated.

(b) To prevent undesirably high temperatures in the aircraft structure adjacent to the engine and jet pipes.

(i) Any period of continuous ground running is to be limited to 15 minutes.

(ii) During any such period, running above 10,000 r.p.m. should be limited to a maximum of 5 bursts of 20 secs, with at least one minute at 7,000-8,000 r.p.m. between bursts.

64. Taxying

(a) Wave the chocks away and set the brake override switch to ON, check that full braking is achieved, return the switch to OFF. Check that there is equal braking effect at each wheel.

(b) Once under way, the aircraft is easy to taxy, and little power is required. The brakes are effective and smooth at high speeds but at very low speeds they are liable to lock on, if over-applied when manœuvring on wet or slippery surfaces. There may also be a reduction in their effectiveness at medium to slow speeds, such as when turning off the runway following a landing.

(c) When wings have been spread operate flaps and airbrakes.

65. Checks before take-off

Trim:—

Elevator	1 div. nose down (flaps UP, clean). *or* Neutral (flaps at TAKE-OFF, clean). *or* 1 div. nose up (flaps at TAKE-OFF, full drop tanks).
Rudder and aileron	Neutral (locking catch engaged)
Aileron trim change-over switch (if fitted)	POWER.
Airbrakes	IN (Selector forward).
Fuel	H.P. and both L.P. cocks fully on. Contents. H.P. pump isolating valve switch as required. Booster-pumps switch NORMAL (lights out). L.P. warning light out.
Wings	Spread and locked. Switch to SPREAD. *Visual indicators flush with wing top surfaces.
Flaps	As required.
Instruments	Set. Pressure head heater ON.
Oxygen	ON, emergency supply connected. (Mk.11 High flow if going above 25,000 ft.) (Mk.17 100% Flow).
Harness	Tight, and locked in rear position.
Hood	If closed, switch forward, clutch release up. If open, switch aft, clutch release up.

Flying controls	Full, free and correct movement. Aileron power switch ON, light out.

*This is the only true indication from the cockpit that the wings are locked spread.

66. **Take-off**

NOTE.—If manual reversion or any form of stick jamming occurs with Power selected ON, immediately switch Power OFF. Do not attempt to re-engage Power; return to base and land in Manual.

(a) Taxy forward to straighten the nosewheel then open the throttle smoothly to the take-off position.

(b) When a short take-off run is essential, align the aircraft, apply the brakes and when the *aircraft is at a standstill* switch ON the brake override, to lock the wheels. Release the handbrake, open the throttle fully and then release the brake override.

(c) Any tendency to swing in cross winds should be corrected by gentle use of brake until the rudder becomes effective at about 60 K.

(d) A strong pull force is initially required to raise the nosewheel off the ground at about 80 K, but as speed increases, this force is gradually reduced and only a very light pull force is required to unstick.

(e) The aircraft unsticks at about 110 K. When airborne apply the brakes and retract the undercarriage. (The nosewheel may be heard to retract forcibly). The undercarriage must be locked up before the speed is allowed to reach 200 K.

(f) When the flaps are raised there is a moderate and fairly quick nose-up change of trim.

(g) If the H.P. pump isolating valve switch has been set ON before take-off, switch it off while still at full throttle

and *at circuit height*, otherwise overfuelling will occur. If the throttle is not fully open when this is done, a rapid drop in r.p.m. will occur corresponding to the amount the throttle has been moved from the fully open position.

NOTE.—If a pump failure has occurred during the time the isolating switch is ON, switching it off will probably result in a flame-out. If it does, immediately return the switch to ISOLATE and press the relight button without carrying out the full relight drill; if this is unsuccessful and time is available carry out the procedure in paragraph 84 (b).

67. Catapult take-off

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

Throttle	Adjust friction.
Flaps	TAKE-OFF.
Wheel brakes	Off. Override switch off (down).
Hood	As required.

(b) During the launch the stick should be held two-thirds to three-quarters aft from the fully forward position. With this stick position the aircraft on leaving the catapult assumes the correct nose-up attitude without further stick movement and a comfortable initial climb results. However, should circumstances necessitate a backward movement of the stick immediately after launching, such a movement should be made slowly and gently to avoid a G stall.

HANDLING IN FLIGHT

68. Climbing

NOTE.—Set cockpit pressure ON after take-off.

(a) When climbing the following speeds are recommended: Clean—Commence the climb at 320 K decreasing by 25 K every 10,000 ft. With drop tanks—Commence the

climb at 295 K decreasing by 20 K every 10,000 ft. Alternatively, with or without drop tanks, use an indicated airspeed of 300 K until 0.66M is reached and then continue at that figure. After take-off the aircraft may be allowed to accelerate while climbing provided that climbing speed is reached below 5,000 ft. If the climb speed is allowed to fall below the recommended figure the rate of climb will be seriously affected, particularly at high altitude.

(b) *Operational climb*

For maximum rate of climb, use 12,500 (12,700) r.p.m. initially and reduce to 12,200 (12,400) r.p.m after 15 minutes. A governor on the engine driven fuel pump restricts the r.p.m. to approximately 12,500 (12,700) for take-off, but with the throttle fully open r.p.m. may increase slightly with altitude and the throttle must be closed progressively in order to maintain the required r.p.m. It may be necessary to reduce power at medium and high altitudes to maintain the j.p.t. within the limits.

(c) *Normal climb*

If the maximum rate of climb is not essential use 12,200 (12,400) r.p.m. and the same airspeeds as in (a) above.

(d) It is recommended that the pressurisation switch be ON at all times as this reduces internal misting to a minimum. In F2 aircraft without pressurisation, the cockpit pressure warning horn will sound at about 9,000 ft. unless the horn switch has been switched OFF. (Refer to para. 39, NOTE).

69. **General flying**

(a) *Flying with ailerons in Power.* The aircraft is easy and pleasant to fly at medium and low altitudes and control is excellent, particularly at low airspeeds.

(i) *Elevator.* At high altitudes and at Mach numbers below 0.78M, the elevator forces are light and in steep turns may at times be negligible. Above 0.78M the elevator becomes progressively heavier

and less effective until, above 0.83M, it has little effect. At high indicated airspeeds the elevator becomes heavy and manœuvrability may then be limited by the control force available.

(ii) *Rudder.* The rudder is very effective at all speeds and considerable roll may be induced by its over-application.

(iii) *Ailerons.* There is little change in aileron control forces with speed thus, above about 150 K, the controls lack the usual harmony. Aileron response is excellent at all speeds but accurate lateral control at high altitude may require some extra concentration due to the sensitivity of the ailerons. Maximum rate of roll is achieved at about 350 K below 0.8M. Full aileron deflection may not be achieved above about 400 K. *When instrument flying, extra concentration is required,* as large angles of bank can be inadvertently applied.

(b) *Trimmers*

NOTE.—Pilots should ensure that the aileron and rudder trimmer switch returns to neutral after use. If it does not do so, it must be re-centred manually.

(i) *Elevator trimmer.* The elevator trimmer is effective up to 0.79M. Above this it becomes progressively less effective and at 0.84M has little or no effect. It is recommended that the elevator trim setting is not altered in this region of reduced control due to the large changes of trim which may occur when the mach number is eventually reduced and the trimmer reasserts itself.

(ii) *Rudder trimmer.* Small amounts of rudder trim may be required as the limiting indicated airspeed is approached.

(iii) *Aileron trimmer.* The use of the aileron trimmer is prohibited with powered ailerons selected, and it must remain locked in the neutral position. Should it be operated inadvertently it will not be detectable by a lateral trim change. Should " manual " engage

in these circumstances, the lateral trim change due to full trimmer cannot be held above 300 K. When Mod. 329 is incorporated the trim control may be used with powered ailerons selected to adjust the spring-feel but the trim change-over switch must be set to Power (see para. 20 (c)).

(c) *Flying with drop tanks fitted*

(i) There is little change in the handling characteristics when drop tanks are fitted except that there is a greater tendency for small lateral oscillations to persist when yaw is applied momentarily, particularly when throttled back at high speed. Accurate lateral control at high altitudes in "power" may be difficult, and there may be a tendency for the control friction to increase at very low temperatures.

(ii) At low altitudes mild buffet becomes apparent at 0.70M. If this speed is inadvertently exceeded the buffet may be accompanied by vibration of the drop tanks, which, for structural reasons, should not be allowed to persist. The Mach number at which buffet first occurs varies linearly with altitude, and at 35,000 ft. does not occur until 0.78M. If the drop tanks are not empty, the onset of tank vibration may be delayed by 0.02M after buffet occurs. In all cases tank vibration decreases with application of G.

(d) *Changes of trim*

(i) *Longitudinal*

Undercarriage down	Negligible.
Flaps from up to TAKE-OFF	Moderate nose down.
Flaps from TAKE-OFF to fully down	Negligible.
Increase in power	Negligible.

(ii) *Lateral and directional*

Lateral trim changes are negligible, but there may be some directional change of trim as the limiting airspeed is approached. Landing with a full drop tank (or equivalent load) on one side presents no difficulty. Adequate lateral control is available down to the stall, whether in Power or Manual.

70. **Flying with the ailerons in Manual**

NOTE.—Power should normally be used on all flights except those undertaken for familiarisation and training. When selecting Manual or Power, the aileron trimmer must be in the neutral position. When Mod. N.329 is incorporated the trim change-over switch should be set the same as the AILERON POWERED CONTROLS — OFF switch.

(a) There are no balance tabs, thus the system in Manual is appreciably heavier, and only small displacements of the control are possible.

(b) Control is adequate up to 300 K and 0.8M but above 300 K it is inadequate for safety when flying near obstructions, near other aircraft, or in poor visibility. Above 0.82M (0.8M with drop tanks) wing dropping tendencies due to compressibility, cannot be held because of the high stick forces.

(c) Take-offs and landings in manual present no difficulty though the normal small lateral trim changes due to uneven flap or undercarriage retraction will be magnified.

(d) Due to the possibility of large lateral out-of-trim forces asserting themselves, power should not be disengaged at speeds above 300 K (0.8M), and never near other aircraft. Following a wing or aileron change or other major repair, the initial check should be carried out at a speed not above 150 K.

(e) *Re-engagement of power in flight*

Before re-selecting Power, the aircraft must be trimmed laterally in straight and level flight at the same airspeed and approximate altitude as when Manual was selected. After re-selection check that the warning light goes out. When Mod. N.329 is incorporated the aileron trim change-over switch must also be returned to power.

(f) *Clearing false anchorages*

If false anchorages occur as described in para. 22 they should be cleared in the following way:—

(i) *One-way restriction*

The control column should be moved rapidly over its full movement in the direction of unrestricted travel. If the airspeed is below 200 K, this can be done without producing excessive aircraft roll.

(ii) *Both-ways restriction*

Firstly, at 150 K with full flap down, by a heavy two-handed effort, the control column should be forced from side to side, thus obtaining a small amount of free travel. Then, having obtained about three to four inches of free travel, the control column should be exercised rapidly and vigorously from side to side until the piston rods slide, enabling the pawls to engage in the slots.

NOTE.—If it is not possible to clear a false anchorage, Manual should be selected and the controls left in Manual until after landing.

71. **Flying at reduced airspeed**

Reduce speed to about 160 K and lower the flaps to TAKE-OFF. Forward visibility in heavy rain is poor.

72. **Flying with the hood open**

Owing to the high noise level and possible hood vibration it is recommended that the aircraft is flown only with the hood closed. It must not be operated at speeds above 160 K.

73. **Flying in turbulent conditions**

The recommended speed is 250 K.

74. Stalling

(a) The stalling speeds, power off or power on, to the nearest five knots are as follows:—

Condition	U/c and flaps up	U/c and flaps fully down
With 2,200 lb. fuel and full ammunition or full internal fuel and no ammunition	100	90
With 90% internal fuel and full ammunition	105	95
With 90% fuel in the drop tanks, full internal fuel and full ammunition	115	100

(b) With flaps and wheels up, warning of the approach of the stall is given by very light buffet some 10 K above and increasing slightly as the stall is approached. With flaps and wheels fully down, the stall warning is less apparent and may not be relied on as a stall warning when landing. At the stall there is a tendency for either wing to drop gently and there is considerable buffet and a high rate of descent. A measure of lateral control is however possible up to 10 K below the stalling speed. Normal recovery action is immediately effective.

(c) (i) At medium and low altitudes, warning of the approach of the stall when G is applied is given by marked airframe buffeting immediately before the stall. If backward movement of the stick is increased at this point, lateral unsteadiness may develop and increase until full aileron will not hold it. Normal recovery action is immediately effective.

(ii) At high altitudes, the elevator forces become very light (provided that the speed is below 0.78M) and it is easy to G stall the aircraft. The stall characteristics are similar to those in (i) above, but there is considerably more warning.

75. **High speed flying**

(a) *Above 30,000 ft.*

The first sign of compressibility is a nose-down trim change which occurs at 0.79M. This increases until at 0.82M a strong nose-up trim change occurs which cannot be held above 0.84M with full forward stick movement. At high altitudes the nose-up trim change may develop into a nose-up pitch at about 0.85M. From 0.79M onwards, the elevator and its trimmer become progressively less effective and are ineffective by 0.84M. There may be considerable elevator buffet and lateral unsteadiness above 0.83M and the full aileron movements which may be required to hold up a wing may cause some yaw. Because of the nose-up trim change, a mach number of 0.86M cannot normally be exceeded in dives up to 60°.

(b) *Below 30,000 ft.*

Compressibility effects are similar to those in (a) above, except that at high airspeeds, the nose-down trim change is usually less powerful as it is offset by the natural nose-up trim change of the aircraft as the airspeed increases. For this reason the nose-up trim change due to compressibility is more powerful, and cannot be held above 0.83M. It is therefore difficult to exceed 0.84M (except in spiral dives or dives over 60°). At 0.83M. there may be considerable elevator buffet and stick vibration which increases as the mach number increases.

(c) *Trimming*

It is recommended that the elevator trimmer is not used above 0.79M., as large angles can be applied in the region of reduced control, and this may lead to excessive trim forces when the mach number is eventually reduced, and the trimmer reasserts itself.

(d) *Use of the airbrakes*

(i) Speed is best reduced at all altitudes by opening the airbrakes and closing the throttle. There is moderate buffet when they are fully open.

(ii) Deceleration is good above 200 K, and changes of trim following the selection are usually small. As the aircraft slows down to below its original trimmed speed, there will be a consequent nose-down change of trim.

(iii) The airbrakes should open fully below 300 K, but above this speed partial opening only may be achieved.

(e) *High speed flying with aileron in Manual*

(i) The wing dropping tendency which becomes apparent in Manual at 0.82M (0.8M with drop tanks) may not be controllable due to the large stick forces involved. For this reason it is recommended that the aircraft is not flown in manual above 0.8M (0.78M with drop tanks).

(ii) A measure of lateral control is available up to the limiting speed of 520 K, but above 300 K this is inadequate for safety under conditions of poor visibility or when flying near obstructions or other aircraft. It is recommended that 300 K is not exceeded in these circumstances.

76. Aerobatics and spinning

(a) Until experience is gained the following minimum speeds are recommended:—

Roll	230 K
Loop	340 K
Roll off the top	360 K
Upward roll	380 K

(b) (i) Practice spins up to 2 turns are permitted and should not be commenced below 20,000 ft. They may be carried out either clean or with empty drop tanks and with ailerons in power or manual.

(ii) The elevator should not be trimmed below 170 K when spinning from turning flight as the aircraft is liable to flick and spin in the opposite direction if recovery from the dive is unduly harsh.

(iii) *Recovery from a spin*

Apply full opposite rudder and ease the stick forward with the ailerons central (i.e. standard recovery action). Care should be taken to allow the speed to build up before easing out of the dive (see (ii) above).

(c) Negative G fuel traps in the front and rear tank groups allow sufficient fuel for 15 seconds inverted flight at sea level at full throttle. Owing to oil starvation this period must not be exceeded. Under negative G conditions oil pressure will fall below the minimum permitted, but should recover within 10 seconds of resuming normal flight. Negative G should not be applied if there is a suspected fault in the fuel supply system. Flight near the vertical should be treated as inverted flight for the purposes of fuel supply.

CIRCUIT PROCEDURE AND LANDING

77. **Checks before landing**

NOTE.—Manual fuel balancing must not be carried out in the circuit.

Airbrakes	In (selector forward)
Undercarriage	Locked down
	Three green lights
Brakes	Off. Check pressure.
	Override selector switch OFF (down).
Arrester hook	As required.
Fuel	Contents. Assess A.U.W. and thus deduce correct approach speed. Booster-pumps switch NORMAL. H.P. pump isolating valve switch as required.

Flaps	Fully down on final approach.
Harness	Tight, locked in rear position.
Hood	As required.
Cockpit pressure	OFF.
G.G.S.	Retracted.

78. **Approach and landing**

NOTE.—600 lb. of fuel should be allowed for the circuit and landing.

(a) The turn on to the final approach should be made at about 140 K with the flaps at TAKE-OFF. Full flap should be selected when turning on to the final approach, and the airfield boundary crossed at the following speeds:—

Maximum permitted landing weight (see para. 57(c))	110 K
With 480-560 lb. remaining, no ammunition	100 K

(b) To ensure prompt and even response to throttle opening it is advisable to keep the r.p.m. above 7,000 until the decision to land has been made.

(c) The brakes should be applied gently and progressively as the aircraft slows down and care should be taken *not to lock the wheels, particularly on a wet runway or one with a poor surface*. Towards the end of the landing run the brakes become less effective.

(d) *Deck landing*. The recommended speed is 105-110 K, depending on the weight.

79. **Going round again**

(a) Increase power as required.

(b) Retract the undercarriage and raise the flaps by stages.

(c) At 150 K begin climbing.

80. **Flapless landing**

(a) A long, very flat approach is necessary, requiring little power. At maximum landing weight the initial approach should be made at 130 K and the airfield boundary crossed at 115 K.

(b) Any excess speed on the approach is very difficult to lose, and careful judgment is required throughout.

(c) The aircraft requires a long landing run, approximately 50% longer than when flap is used.

81. **Instrument approach**

The following speeds, clean, with the appropriate flap and approximate power settings are recommended for use during instrument approaches with the undercarriage lowered:—

	R.p.m.	Flaps	Airspeed
Pattern	9,500	UP	160 K
Base leg	9,000	UP	150 K
Glide-path	9,000	TAKE-OFF	115-120 K

NOTE.—The "search" ranges at which G.C.A. can pick up single aircraft may be lower than normal.

82. **Checks after landing**

Hydraulic pressure	Sufficient for taxying
Booster-pumps and all non-essential electrical services	Off.
Flaps	UP.

83. **Stopping the engine**

Allowing the J.P.T. to stabilise with the r.p.m. at 7,000-8,000, close the throttle fully and stop the engine by turning off the H.P. cock, then:—

V.H.F.	OFF.
Inverter reset relay	Push top button.
Engine master and igniter switches	OFF.
Battery isolating switch	GROUND.
Chocks	In position.
Wheel brakes	Off.
Ejection seat	Secure safety strap.
Wings	Wing fold selector switch corresponding to position of wings.
Both L.P. fuel cocks	Off.
Power controls	Off.

PART IV
EMERGENCY HANDLING

84. **Engine failure and relighting in flight**

(a) *Mechanical failure*

(i) If the engine fails due to obvious mechanical causes immediate action should be:—

Close throttle
H.P. and L.P. cock OFF
Booster-pumps switch OFF (central)
Switch off all non-essential electrical services
Do not attempt to relight; carry out forced landing procedure.

(ii) *Gliding with engine stopped* The aircraft glides approximately 2.5 nautical miles per 1,000 ft. at all altitudes and A.U.W.s at 180 K.

(b) *Sudden drop in engine r.p.m.*

If an inexplicable drop in engine r.p.m. occurs, close the throttle fully and set the H.P. pump isolating-valve switch to ISOLATE. Then open the throttle carefully to check engine response.

(c) (i) If flame-out occurs, close the throttle and H.P. cock, switch off all non-essential electrical services including the booster-pumps and reduce speed to below 200 K and height to below 20,000 ft. before attempting to relight.

(ii) Failure of the negative G traps to function correctly when negative G is applied, or incorrect tank selection may result in flame extinction owing to air locking in the H.P. pumps. *In such cases the I.A.S. must not exceed 150K when relighting.*

(d) (i) *Relight drill*

Set:

Engine starter master switch	ON
Igniter switch	ON
Igniter circuit breaker	In
Booster-pumps switch	RELIGHT & EMERGENCY
Throttle	Fully closed
H.P. pump isolating-valve switch	ISOLATE (only if failure of the engine fuel system is suspected)
H.P. cock and relight button	Press button and open H.P. cock simultaneously. Keep button pressed for 30 secs. maximum.

(ii) When r.p.m. or j.p.t. begin to rise, release the relight button and when at idling r.p.m. for the altitude open up carefully to the desired r.p.m. Then set the booster-pumps switch to NORMAL.

(iii) If the relight has been carried out with the isolating switch at ISOLATE it must remain at ISOLATE for the rest of the flight, including landing. The A.C.U. will be ineffective and at low altitudes it may not be possible to obtain maximum r.p.m.

(iv) Should the engine fail to relight after 30 seconds turn off the H.P. cock. Attempt a further relight at a reduced altitude and airspeed.

NOTE. Relighting is accomplished more readily at lower altitudes and airspeeds.

85. Emergency relighting

In circumstances where the engine cannot be relit by the above drill, *provided that the pilot is reasonably certain that the fault lies in the relight button circuit*, it may be possible, as a last resort, to obtain a light up by using the normal engine starter switch. It is imperative, however, that r.p.m. should be in excess of 500 before this method is attempted otherwise there is a risk of the cartridges firing which will overspeed the starter, thus cutting out the igniter circuit.

86. Action in the event of fire

(a) If the engine fire warning light comes on, the throttle should be closed immediately. Then proceed as follows:—

Both L.P. cocks	OFF
H.P. cock	OFF
Booster-pumps switch	OFF
Pressurisation	OFF
Oxygen	EMERGENCY
Airspeed	Low as possible

Then press the fire-extinguisher button. If the fire is extinguished the light goes out. Should the fire persist and the light remain on, the aircraft should be abandoned.

NOTE. 1. If the light goes out within 5 seconds of closing the throttle, a fractured air casing as distinct from fire is indicated. It is safe to use the engine in this condition, provided the power required is low enough for the light to remain out.

2. Temporary waves of excessive heat may cause flickering of the fire warning light during certain manoeuvres and during engine run on the ground.

(b) If the tank fire warning light comes on, indicating fire in either of the fuel tank bays, the aircraft must be abandoned.

87. Hood jettisoning

(a) The hood should be jettisoned at the lowest practicable speed by pulling the T handle at the top port side of the instrument panel. Before jettisoning, lower the seat fully and keep the head well down.

(b) When the jettison handle is pulled it mechanically:—

Deflates the hood seal

Declutches the hood winding motor

Raises the seat thigh guards

Operates the two hood release units to jettison hood.

In addition, if power is available, it *electrically*:—

Retracts the G.G.S.

Shuts off the cockpit pressure

Opens the air extractor valve.

(c) The hood may be jettisoned *externally* by breaking a perspex panel on the port side and operating a manual release, thereby enabling the hood to be lifted clear.

88. **Drop Tank/Bomb Jettisoning**

Aircraft mark	Stores to be jettisoned	Power required	Switch to be operated
2	Drop tanks*	Electric and hydraulic	Switch (93)
3 & 5	Drop tanks (post mod. N.247) *or* bombs	Electric	Switch on bomb control panel
4 & 6	Drop tanks Inner bombs Outer bombs	Electric	Push-button (27) on bomb control panel
3, 4, 5 & 6	Drop tanks (pre Mod. N.247)* *or* (Post Mod. N.247). Drop tanks *and* pylons *or* Bombs *and* pylons.	Electric and hydraulic	Switch (93)

* Unless mods. N271 and N357 are incorporated jettisoning speed of these stores is restricted to 200 K. Otherwise, all stores may be jettisoned at any speed within the limitations applying to those stores.

89. **Gyro gun sight emergency lowering**

(a) Whenever electrical power is available the G.G.S. will be retracted automatically when the hood is jettisoned.

(b) If electrical power is not available the G.G.S. may be lowered by striking the knob to the right of the sight a hard blow. Normally this action should be sufficient to lower the sight, but it may be necessary to push the sight manually to the retracted position.

90. Emergency oxygen system

(a) The emergency bottle is carried in the dinghy pack in the seat well. If the pin is removed, the supply is automatically brought into action when the ejection seat is operated.

(b) Should the normal oxygen supply fail or be suspect, the emergency bottle can be brought into operation by pulling the knob on the cockpit floor by the starboard side of the seat.

(c) The duration of the supply is 12 minutes.

91. Abandoning the aircraft

(a) *Automatic seat*

(i) Reduce speed as much as possible and set the parachute container fully back.

(ii) Lower the head, jettison the hood, retract the G.G.S. and see that the thigh guards are raised. (The G.G.S. and thigh guards operation should be automatic on jettisoning the hood.)

(iii) Draw the handle and face screen firmly over the face keeping the head pressed hard against the headrest. It is not necessary to jerk the handle and in no circumstances should the blind be pulled outwards away from the face, as it may not then be possible to fire the cartridge.

(iv) After ejection, the drogue gun will fire automatically.

(v) If ejection takes place below 10,000 ft. automatic separation will be within 5 seconds (3 seconds if Mod. 187 is incorporated). If above 10,000 ft. automatic separation will not occur until that height is reached.

NOTE.—The minimum height for safe ejection in *straight and level* flight is 500 feet. (200 ft., minimum speed 120 K when Mod. 187 is incorporated.)

(b) *Action should the automatic mechanism of the seat fail*

If, after ejection, the pilot for any reason doubts the serviceability of the automatic parachute releasing mechanism he should operate the parachute manually as follows:—

(i) Pull the first "D" ring on the parachute harness.

(ii) Release the restraining straps from the seat.

(iii) Release the safety harness.

(iv) After falling clear of the seat pull the second "D" ring to develop the parachute canopy.

(c) *Action should the automatic seat fail to eject*

(i) Pull first "D" ring on parachute harness.

(ii) Proceed as on aircraft not fitted with an ejection seat. (Under these circumstances the parachute will not be opened automatically.)

92. **Undercarriage, flaps, arrester hook and powered ailerons emergency operation**

NOTE.—1. Operation of emergency air systems on either flaps or undercarriage results in a large loss of hydraulic fluid with a consequent loss of hydraulic pressure. This loss of fluid can be minimised by selecting undercarriage and flaps down on the normal selectors before using the emergencies.

2. After use of the emergency system the ailerons will almost certainly revert to Manual. Pilots are therefore recommended to select Manual before operating emergencies.

3. In all cases of electrical failure, it will be necessary to use the emergency controls. It will not be possible to raise the undercarriage or flaps once the emergency controls have been used.

4. If it is necessary to land when the nose-wheel is down but the red light shows it to be unlocked, select manual ailerons and do not stop the engine or operate the hydraulic services until a support has been placed under the nose.

(a) *Undercarriage*

(i) If the undercarriage fails to lock down by using the normal control, use the emergency control. It will operate irrespective of the position of the normal selector, but if the normal control is left in the UP position and electrical power is available, the nose-wheel red light will remain on. The normal control should therefore be set to DOWN and, if the wheel is properly locked down, the green light will come on.

(ii) If the undercarriage emergency control is used *after* the flaps have been lowered by *hydraulics* there is a possibility of the flaps creeping up.

(iii) Should one undercarriage leg remain fully retracted, although there is no sign of hydraulic failure, then a mechanical defect is the cause. Under the circumstances nothing is to be gained by operating the emergency system, as this will only result in a loss of hydraulic fluid and the inability to make any further hydraulic selections. Pilots are advised not to use the emergency system when a mechanical defect of one undercarriage leg is suspected.

(iv) To raise the undercarriage on the ground in an emergency following the normal selection down, press the UP selector button firmly. There is no emergency override.

(b) *Flaps*

If the flaps fail to lower by the normal selector, they may be selected fully down only, by using the emergency control. They may not lower fully, however, until the speed is reduced to about 130 K. Do not use the emergency control at speeds above 150 K.

(c) *Arrester hook*

If the main hydraulic system fails, attempt to lower the arrester hook by the normal control first. If this is not successful or if the failure is an electrical one, the emergency control must be used. The hook will then lower, provided there is still pressure in the hydraulic accumulator. If electrical power is available, the hook may usually be raised by operating the normal selector switch up and returning the emergency control to its original position.

(d) *Powered ailerons*

(i) If the main hydraulic failure warning light comes on, denoting pump failure, the aileron powered controls will continue to operate for a limited time on their separate accumulator. During this time, speed should be reduced to below 300 K (or 0.8M). Between 5 and 10 full aileron movements will exhaust the accumulator and the controls will then revert to Manual automatically. If the failure is in the main hydraulic system, control response at high I.A.S. may "fade" gradually as the accumulator pressure is used, but normally no such warning should be expected. (See paragraph 18 (c).)

(ii) If the electric power should also fail while in Manual (e.g. engine failure) the system will automatically re-engage to Power, regardless of the switch position. Thus, *whenever* the hydraulic system fails, the

accumulator should be exhausted purposely before reverting to Manual. This will prevent the possibility of the powered controls auto-changing at an awkward time.

93. **Landing following an hydraulic failure**

NOTE.—The brakes override switch is not intended as an emergency braking system. However, if the normal braking system fails during taxying when hydraulic pressure is available, it may be used to stop the aircraft. Use of the switch locks the wheels solid by by-passing the differential relay valve. Depending on forward speed, its use may result in bursting one or both main wheel tyres.

(a) Immediately the aircraft is firmly on the runway, apply the brakes gently, progressively increasing the amount of brake as the aircraft slows down.

(b) Do not apply the brakes intermittently during the landing as this rapidly exhausts the accumulator.

(c) Extreme caution should be exercised when taxying to avoid being under way when pressure is exhausted.

(d) A fully charged accumulator contains enough pressure for about nine applications of the brakes.

94. **Forced landing**

(a) It may be advantageous, when making a forced landing, to have the undercarriage down. Pilots should carefully consider the probable advantages, in most cases, of reducing impact load by this means.

(b) Jettison the hood when below 10,000 ft.

(c) Close the H.P. and both L.P. cocks, switch off the booster-pumps switch, and all non-essential electrical services.

(d) Release the parachute harness, dinghy pack attachments and oxygen leads (if below 10,000 ft.).

(e) Lower the seat, tighten and lock the safety harness in the rear position.

(f) Maintain a speed of not less than 150 K while manœuvring for the final approach. If hydraulic and electric power is available lower the flaps to the TAKE-OFF position directly it is seen that a touch-down in the chosen landing area is certain. On crossing the boundary of the landing area, lower the flaps fully. (If emergency flap selection is necessary, the flaps will lower fully only, thus the emergency control should only be used when the landing area is reached.) With full flap, the approach path is steep, thus involving a large change of attitude on rounding out. The round out should therefore be started at not less than 130 K.

95. **Ditching**

(a) Model tests of an aircraft indicate that the ditching characteristics are satisfactory with or without drop tanks.

(b) If it is decided to ditch, the following procedure should be adopted:—

(i) Initiate distress procedure.

(ii) Jettison the hood below 10,000 ft. and see that the G.G.S. is retracted.

(iii) Disconnect all oxygen leads (if below 10,000 ft.) and release the parachute harness.

(iv) Jettison all external stores.

(v) Lower arrester hook to help judge height.

(vi) Check dinghy attachments.

(vii) Tighten and lock the safety harness in the rear position. Lower the seat.

(viii) Lower the flaps to the LANDING position and aim to enter the water at as low a forward speed and rate of descent as possible.

(ix) Ditching should be along the swell, or into wind if the swell is not steep.

PART V
TARGET TOWING

96. Introduction

Sea Hawk aircraft are cleared for drag or snatch launching and towing of 30 ft. banner targets in I.S.A. to I.S.A. + 17°C conditions when either Mods. N.252 and N.1035 or Naval Service Mod. No. 3006 are embodied. With Mods. N. 252 and N. 1035 the towing cable is made up of 50 ft. of steel cable, 100 ft. of webbing and from 650 to 800 ft. of nylon rope. The steel cable is always nearest the aircraft. With N. S. Mod. 3006 the nylon rope only is used. Paras 102 and 103 will be issued by amendment when Dart and Excelsior targets are cleared for service use.

97. Controls

(a) *Mods. N.252 and N.1035*

Single or twin release units are fitted beneath the fuselage, only one of which can be used at a time. A three-position selector switch (74), for the normal release and a three-position EMERGENCY switch (75) for emergency release, are both mounted on the cockpit starboard wall. For normal release, the appropriate selector switch is made and release is effected by pressing the camera button on the control column. Emergency release is effected by selecting the appropriate position on the EMERGENCY switch without recourse to the camera button.

(b) *N.S.Mod. No. 3006*

The banner is towed from the arrester hook by means of a special attachment. Electrical release is affected by switching on the navigation lights and in the event of the failure of that circuit, mechanical release is effected by lowering the hook.

98. **Limitations**

(a) *Mods. N. 252 and N. 1035*

(i) Maximum speed on tow.....240 K (Target restriction).

(ii) Maximum A.U.W .....14,800 lb.

(iii) Maximum rate turn on tow.....Rate 1.

(iv) If the target breaks away, speed must be reduced below 180 K.

(v) The arrester hook and type 100 aerial must be removed.

(b) *N.S.Mod. No. 3006*

(i) Maximum continuous towing speed 230 K (new cable).

(ii) Maximum continuous towing.....190 K speed (used cable)

(iii) Maximum rate turn on tow.....Rate 2.

99. **Performance**

(a) *Take-off*

For either drag or snatch take-off, TAKE-OFF flap and 12,500 (12,700) r.p.m. are recommended. In each case the aircraft should be flown off at 95-100 K (105-115 K when carrying full drop tanks) and the initial climb to 1,000 ft.

made at 110-120 K (120-130 K when carrying full drop tanks).

(b) *Take-off distances (Nene 103)*

The table below gives the zero wind take-off distances (in yds.) for various configurations and temperature conditions.

Configuration		I.S.A.		I.S.A.+12°C.		I.S.A.+17°C.	
		Drag	Snatch	Drag	Snatch	Drag	Snatch
Clean	Ground run	630	500	720	570	760	590
	Target to 50 ft.	1,280	890	1,400	990	1,450	1,020
With drop tanks	Ground run	800	700/750	930	800/850	980	840/890
	Target to 50 ft.	1,500	1,140/1,190	1,660	1,270/1,320	1,730	1,330/1,380
With drop tanks and ammo.	Ground run	860	700/750	1,000	800/850	1,060	840/890
	Target to 50 ft.	1,560	1,140/1,190	1,730	1,270/1,320	1,810	1,330/1,380

(c) *Climb*

The climb from 1,000 ft. should be made at 200 K using 12,200 (12,400) r.p.m. Initial rates of climb and times to 20,000 ft. in I.S.A. conditions are as follows:—

	Ft./Min. at sea level	Time to 20,000′ (minutes)
Clean	2,600	10½
With drop tanks	2,200	14
With drop tanks and ammo.	2,050	16½

(d) *Level flight* (I.S.A. conditions)

(i) At 10,000 ft. the limiting airspeed can be reached using 11,600 r.p.m. when carrying drop tanks.

(ii) At 20,000 ft. when carrying drop tanks 240 K can be reached by using 12,400 r.p.m. and 210 K by using 12,000 r.p.m.

(e) *Endurance*

Total fuel	4,376 lb. (150 galls in drop tanks).
Take-off and climb to 1,000 ft.	480 lb.
Descent and landing	800 lb.
Total available for climb and cruise	3,096 lb.

At 20,000 feet, taking into account the time and fuel used on the climb, the endurance varies from 1.23 hours at 180 K to 1.03 hours at 210 K.

100. **Handling**

(a) *Take-off and climb*

The handling is no different from normal. No wing dropping occurs during take-off and initial climb.

(b) *Cruising*

With the target on tow the handling characteristics are normal with a negligible chance of trim. The tow rope is usually in a position very close to the underside of the aircraft and if the rate of turn is increased above the maximum permitted (Rate 1) the clearance is reduced until at about rate 1½ the rope begins to chafe on the fuselage undersurface.

(c) *Descent*

Descents on tow are best made at 200 K, 10,000 r.p.m. airbrakes out.

(d) *Approach and release*

Reduce speed to 150 K, lower the flaps to the TAKE-OFF position and release the target at a minimum height of 200 ft. at a speed of 130 K.

101. **Emergency handling**

If the target breaks away, the portion attached to the aircraft should be jettisoned immediately, if the area is suitable. If the cable cannot be jettisoned speed should be kept below 180 K to prevent the cable lashing and fouling the controls. Loose cable should be dropped from at least 500 ft. to make sure it does not foul ground obstacles.

102. **To be issued by amendment**

103. **To be issued by amendment**

PART VI
OPERATING DATA

104. Loading and C.G. data

NOTE.—When making loading and C.G. calculations reference should always be made to A.P.4328B to F, Vol. 1 Sect. 2 Ch. 3.

(a) In order to keep the C.G. within the approved range at take-off it will normally be found necessary to carry the following ammunition loads, or ballast in lieu:—

F2 aircraft ... ... 800 rounds
FB3 & 5 and FGA4 & 6 aircraft ... 300-600 rounds

(b) When reconnaissance cameras are carried ballast weights must be fitted in the forward part of the fuselage.

(c) It is essential that the loading is kept within the approved C.G. limits at all stages of flight allowing for the effect of using fuel, firing ammunition and R.P.'s and dropping bombs.

(d) Consumption of fuel causes the C.G. to move forward. Firing ammunition causes the C.G. to move aft.

(e) *Typical service loads*

The approximate typical service loads listed below are for guidance only and will vary according to the modification state.

Condition	Approx. Weight—lb.		
	F2	FB3 & 5	FGA4 & 6
Clean aircraft*	13,400	13,400	13,500
With full drop tanks	15,100	15,100	15,200
With 2×500 lb. bombs	—	14,500	14,700
With 2×1,000 lb. bombs	—	15,600	15,800
With 20×25 lb. R.P.	—	—	14,900
With 10×60 lb. R.P.	—	—	15,000
With 10×60 lb. R.P. and drop tanks	—	—	16,200

*"Clean" refers to an aircraft with full service load, i.e. full internal fuel and ammunition, etc.

105. **Pressure error corrections**

(a). The following are the pressure error corrections in knots at sea level over the cruising speed range of the aircraft:—

IAS	100	150	200	250	300	350	400
PEC	−5	0	+2	+3	+4	+5	+6

(b) The following are the altimeter corrections, in feet at sea level:—

IAS	100	150	200	250	300	350	400
Altimeter corrn.	−60	0	+40	+90	+130	+200	+300

106. **Carrier operation**

(a) *Catapulting data*

Max. weight: Mk. 2 15,100 lb.
Mks. 3 & 5 15,600 lb.
Mks. 4 & 6 16,200 lb.

Aircraft weight lb.	13,500	14,000	14,500	15,100	15,600	16,200
Minimum catapult air-speed knots TAS	106	108	110	112	114	116
End speed—K	94	93	92	91	90	87
BH5 Min. wind down —K	12	15	18	21	24	29
Max. acceleration—G	4.9	4.8	4.7	4.6	4.5	4.2

(b) *Arresting data*

Max. weight: 12,000 lb. (13,300 lb. in emergency)

Max. approach speed:

With mirror sight	117 K.T.A.S.
Without mirror sight	120 K.T.A.S.
Max. retardation (on centre)	3.7G.

Min. wind down

Mk. 11 Arrester (entry speed 87 K).

With mirror sight	30 K.
Without mirror sight	33 K.

Mk. 10 and 13 Arrester (entry speed 92 K).

With mirror sight	25 K.
Without mirror sight	28 K.

NOTE.—Aircraft may suffer structural damage when entering the Mk. 6 jet barrier at speeds in excess of 72 K off centre or 82 K on centre.

(c) *Free deck take-off*

Unassisted take-offs are permitted with a 700 ft. run at the following weights and relative wind speeds down the deck.

Weight—lb.	Wind speed K.
11,000	32.9
11,500	37.5
12,000	42.1
12,500	46.8
13,000	51.5

and pro rata intermediately.

107. **Flight planning data**

(a) The tables on the following pages show the flight planning data for different configurations.

(i) *Climbing*

The climb tables give the data for climbs in I.S.A. conditions using the speeds recommended in para. 68.

(ii) *Cruising*

Each separate altitude block in the cruise tables shows:—

1. The speed for maximum range, the approximate A.N.M./100 lb. and the approximate fuel consumption for the particular height. In addition a speed band is given, use of any speed within which should not cause more than a 5% reduction in range.

2. The range obtainable for various amounts of available fuel when flying at the best range speed for the height. The range given is to the point of let-down, allowance being made for the descent fuel required.

3. The range obtainable for various amounts of available fuel, including the distance covered on the climb, if a climb is made to another altitude. In this case the climb must be made at the speed given in para. 68 and the flight continued at the

new altitude at the best range speed for that height.

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

(iii) *Descent*

The descent tables give the data for descending from one height to another.

(b) *Use of the tables*

NOTE.—When a Nene 103 engine is fitted the increased performance is as follows: —

Rate of climb	...	...	Increased by 12%
Combat speed	...	...	Increased by 1%
Combat radius	...	...	Increased by 1%
Combat endurance		...	Increased by 3%

(i) *Pre-flight planning*

Enter the cruise data table in the sea level block at the fuel state applying immediately after take-off. Select the height at which maximum range is available at that fuel state. The distance available includes distance covered on the climb, but not on the descent. (Absolute maximum range is obtained by adding on the descent distance, provided that the let-down is commenced at that distance from the destination.)

(ii) *In-flight planning*

At any stage of a flight the available range may be ascertained by applying the fuel state to the level flight range in the particular altitude block.

If an increase in range is required, or if a climb has to be made, the new available range may be obtained by entering the existing altitude block at the particular fuel state and moving vertically down-

wards within the block until the new altitude is reached. Figures in heavy type indicate the best altitude for the maximum increase in range. Above these heights no further range increase is possible. If a descent is necessitated the new range is shown by moving direct from the existing altitude level flight range for the particular fuel state to the new altitude level flight range.

(c) *ANM/100 lb. curves*

Curves on pages 96 to 101 show the approximate A.N.M./100 lb. fuel for various altitudes, true mach numbers and r.p.m. settings. The horizontal curves are the A.N.M./100 lb. curves for the altitude shown; the vertical dotted curves are the approximate r.p.m. settings required to achieve various true mach numbers. For heights other than those given interpolation is possible.

CLIMB DATA — CLEAN AIRCRAFT

TOTAL FUEL 3,160 lb.
TAXY AND TAKE-OFF ALLOWANCE 240 lb. (Airfield)
180 lb. (Carrier)
LANDING ALLOWANCE 600 lb.
(excluding descent fuel)

FROM	TO	FUEL LB.	DIST.	MINS.
Sea Level	10,000′	180	11	2
	20,000′	360	26	5
	30,000′	560	49	9
	40,000′	820	95	16
10,000′	20,000′	180	15	3
	30,000′	380	38	7
	40,000′	640	84	14
20,000′	30,000′	200	23	4
	40,000′	420	69	11
30,000′	40,000′	220	46	7

Climb at 12,500 r.p.m.

DESCENT DATA — CLEAN AIRCRAFT

FROM	TO	FUEL LB.	DIST.	MINS.
40,000′	30,000′	30	5	1
	20,000′	70	10	2
	10,000′	110	15	3
	Sea Level	150	25	5
30,000′	20,000′	40	5	1
	10,000′	80	10	2
	Sea Level	120	20	4
20,000′	10,000′	40	5	1
	Sea Level	80	15	3
10,000′	Sea Level	40	10	2

THROTTLE .. .. CLOSED
AIRBRAKES .. .. IN
SPEED .. .. 0.72M above 20,000′
350/360K below 20,000′

CLIMB DATA

With 2 x 75 gall. Drop Tanks OR 2 x 500 lb. Bombs

FROM	TO	FUEL LB.	DIST.	MINS.
Sea Level	10,000′	220	12	3
	20,000′	450	30	6
	30,000′	720	60	12
10,000′	20,000′	230	18	3
	30,000′	500	48	9
20,000′	30,000′	270	30	6

CLIMB DATA

With 2 x 1,000 lb. Bombs OR 10 x 60 lb. Head R.P.s

FROM	TO	FUEL LB.	DIST.	MINS.
Sea Level	10,000′	240	13	3
	20,000′	500	33	7
	30,000′	800	66	13
10,000′	20,000′	260	20	4
	30,000′	560	53	10
20,000′	30,000′	300	33	6

CLIMB DATA

With 4 x 500 lb. Bombs

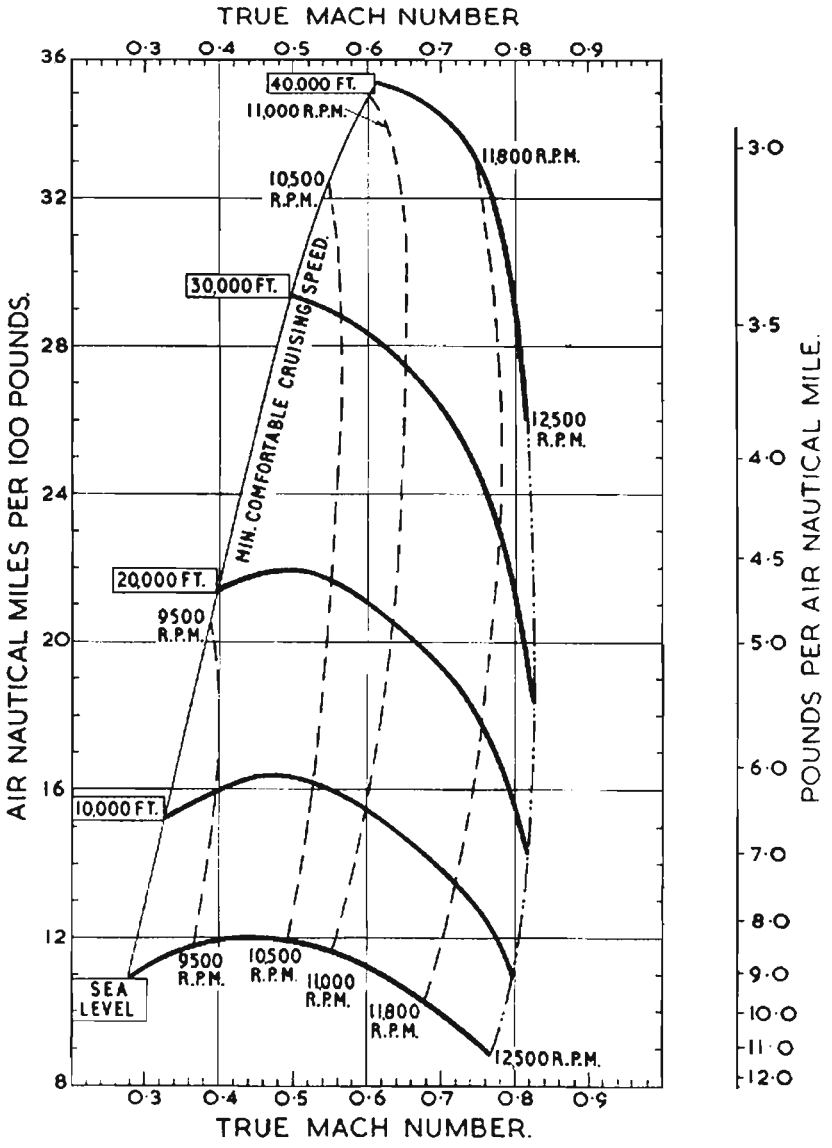
FROM	TO	FUEL LB.	DIST.	MINS.
Sea Level	10,000′	260	14	3
	20,000′	530	33	7
	30,000′	840	67	14
10,000′	20,000′	270	19	4
	30,000′	580	53	11
20,000′	30,000′	310	34	7

CLIMB DATA

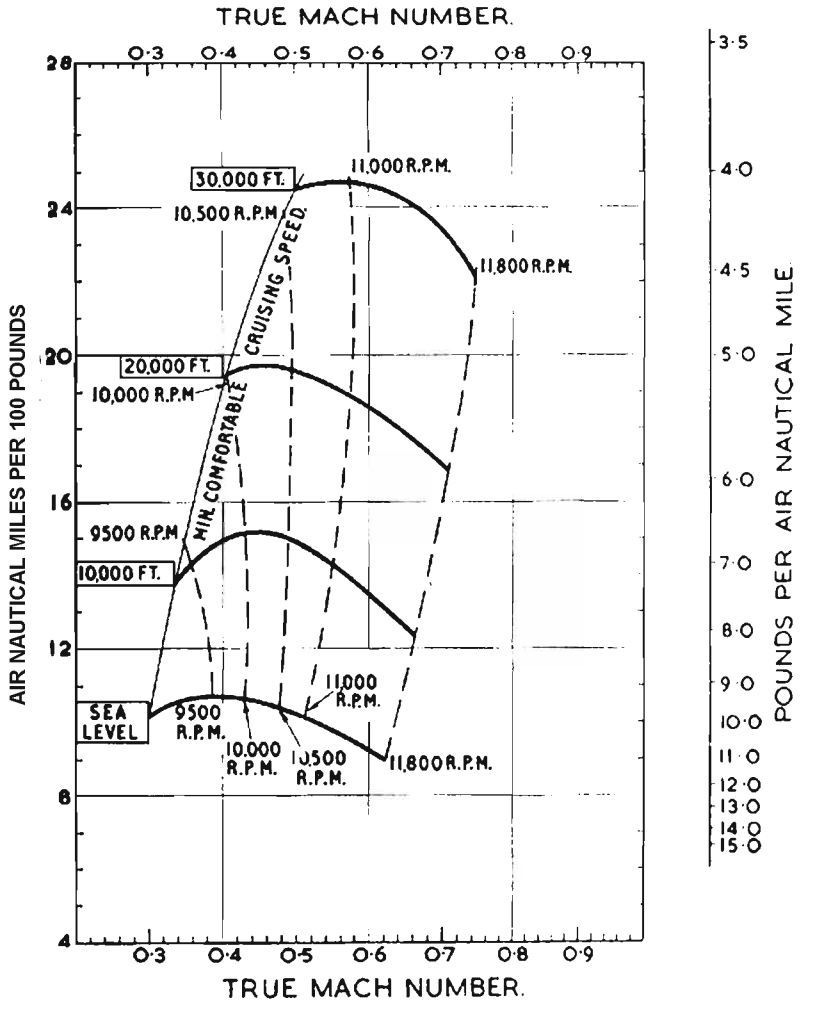
With 20 x 25 lb. Head R.P.s

FROM	TO	FUEL LB.	DIST.	MINS.
Sea Level	10,000′	290	15	3
	20,000′	600	38	8
	30,000′	990	79	16
10,000′	20,000′	310	23	5
	30,000′	700	64	13
20,000′	30,000′	390	41	8

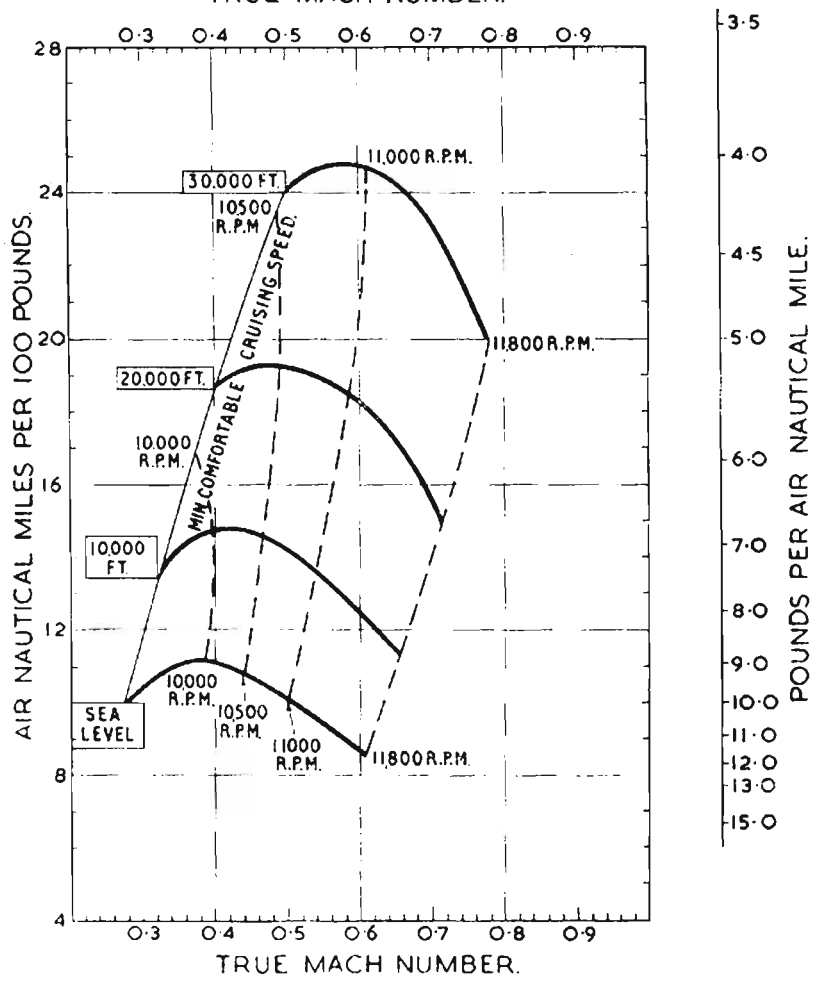
CLEAN AIRCRAFT.



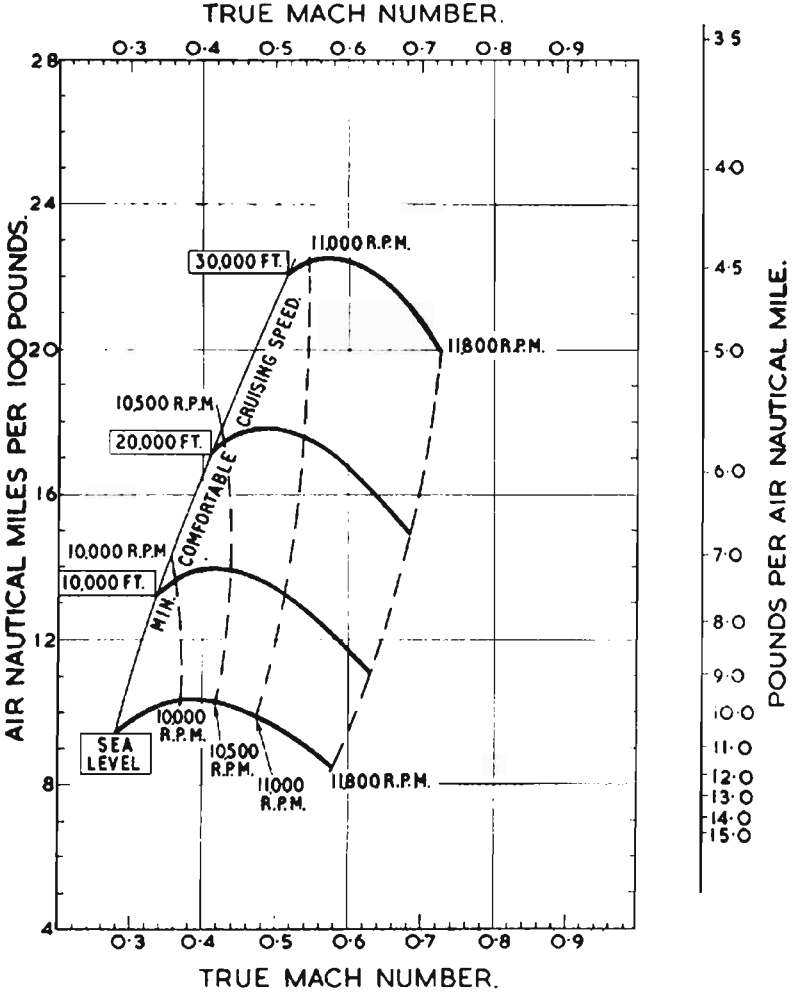
WITH 2 x 77 GALLON TANKS.



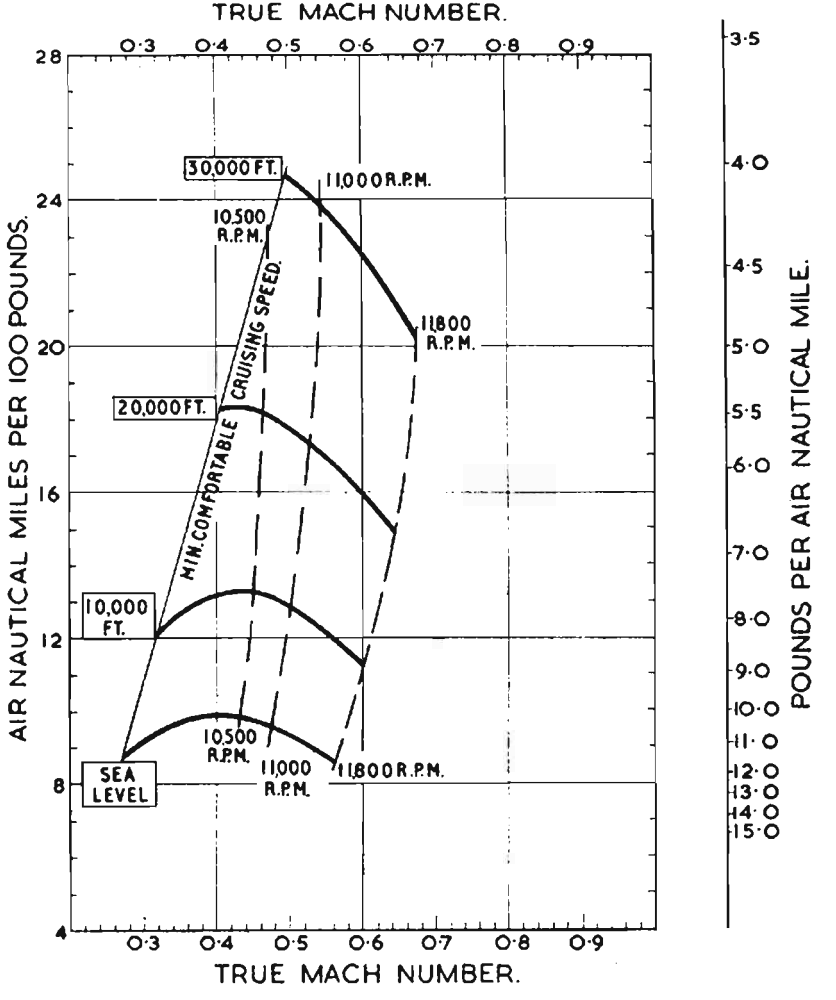
WITH 2x500 LB. BOMBS.



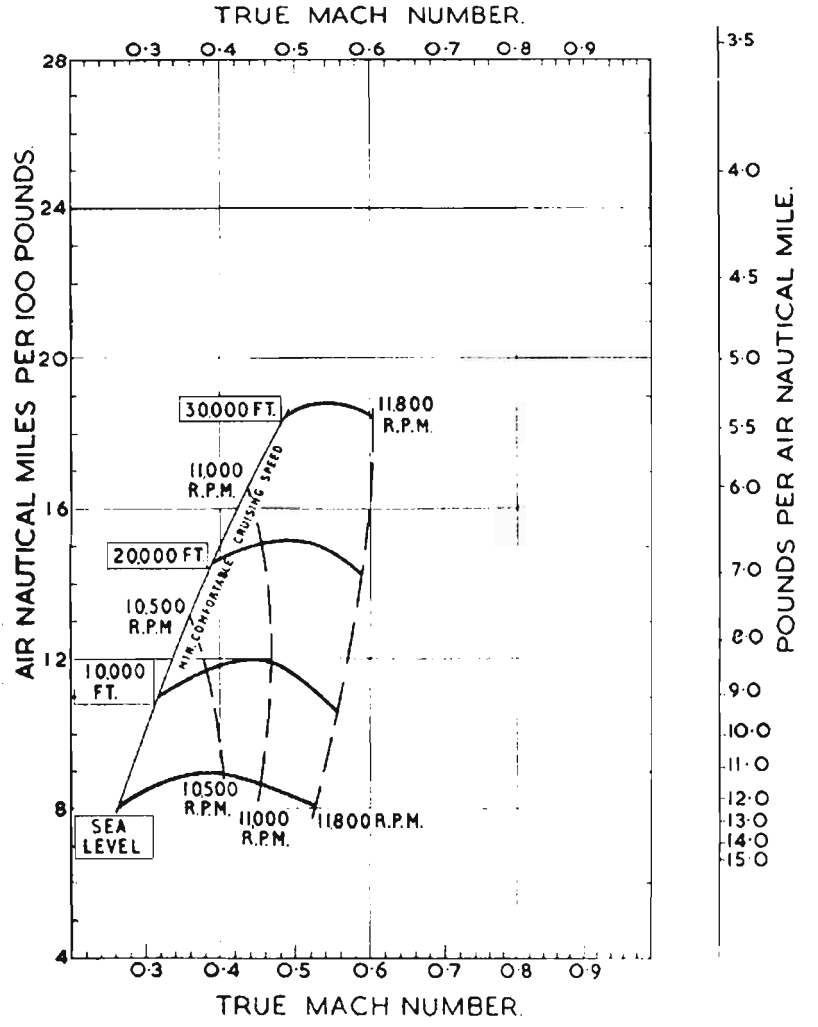
WITH 2x1000 LB. BOMBS OR 4x500 LB. BOMBS.



WITH 10x60 LB. HEAD R.Ps.



WITH 20 x 25 LB. HEAD R Ps.



108. **Take-off distances**

The table below gives Ground Run and Distance to 50 ft., in various conditions, for Mks. 2, 3 and 4. The distances will be decreased by 8% for Mks. 5 and 6 (Nene 103). Above sea-level the distances will be increased by 7% per 1,000 ft.

Take-off weight lb.		13,600		16,200	
Wind-speed	K	0	30	0	30
	Temp. °C.				
Ground run—ft.	—15	1,525	765	2,300	1,230
	0	1,820	930	2,775	1,515
	+15	2,200	1,150	3,385	1,890
	+30	2,680	1,430	4,175	2,370
	+45	3,250	1,765	5,150	2,970
To clear	—15	2,395	1,285	3,575	2,020
50 ft.—ft.	0	2,855	1,560	4,320	2,475
	+15	3,440	1,910	5,270	3,075
	+30	4,195	2,365	6,505	3,855
	+45	5,085	2,905	8,050	4,825

PART VII
ILLUSTRATIONS

KEY TO FIGS. 1, 2 & 3.

1. Rudder and aileron trim position indicator.
2. Rudder and aileron trim control.
3. H.P. cock lever and relight button.
4. Camera oblique/vertical switch.
5. Wing fold control switch.
6. Elevator trim control.
7. Flaps emergency air pressure gauge.
8. L.P. cocks levers.
9. Triple pressure gauge (when Mod. N246 is incorporated).
10. Undercarriage/arrester hook emergency air pressure gauge.
11. I.F.F. master switch.
12. Hood lock release lever.
13. Hood control switch.
14. Hood motor de-clutching lever.
15. Throttle lever and press-to-transmit switch.
16. Airbrakes control.
17. Armament master switch.
18. G.G.S. Guns/RP switch.
19. R.P. selector switch.
20. Arrester hook emergency control.
21. Undercarriage emergency control.
22. Flaps emergency control.
23. Flaps control.
24. Outer bomb selector switches.
25. Inner bomb selector switches.
26. Bomb distributor switch.
27. Bomb jettison pushbuttons.
28. Bomb fusing switch
29. Bomb control panel fuse holder.
30. Bomb fuse warning light.
31. Cockpit heat control.
32. Anti-G control panel.
33. G.G.S. selector/dimmer control.
34. Air temperature gauge.
35. Undercarriage position indicator.
36. Undercarriage selector pushbuttons.
37. Flaps position indicator.
38. Undercarriage warning light.
39. R.A.T.O.G. pushbutton.
40. Arrester hook green light.
41. Arrester hook switch (training switch outboard).

42. Hood Jettison control.
43. Deck landing A.S.I.
44. Fuel tanks fire warning light.
45. G.G.S. master and retraction switch.
46. Top generator failure warning light.
47. Bottom generator failure warning light.
48. Fuel pressure warning light.
49. G.G.S. emergency lowering control.
50. E2 compass.
51. Engine fire warning light and extinguisher button.
52. Port and starboard demister switches (Inoperative).
53. G45 camera aperture switch.
54. Front fuel contents gauge.
55. Rear fuel contents gauge.
56. Cockpit pressure altimeter.
57. ARI.18049 indicator.
58. Inverter reset relay switches.
59. Windscreen demisting control.
60. Oxygen contents gauge.
61. Windscreen de-icing pump.
62. Turn and slip indicator emergency switch.
63. Mk. 17 oxygen regulator.
64. Bomb/RP pushbutton.
65. G45 camera pushbutton.
66. J.p.t. gauge.
67. Engine starter switch.
68. Engine starter master switch.
69. Engine igniter switch.
70. Engine igniter circuit breaker.
71. H.P. fuel pump isolating valve switch.
72. H.P. fuel pump isolating valve switch warning light.
73. Cockpit pressure control.
74. Target release selector switch.
75. Target emergency release switch.
76. Red lamps master switch.
77. Emergency lamp switch.
78. V.H.F. control unit.
79. Cockpit pressure warning horn cut-out switch.
80. Pressure head heater and G45 camera master switches.
81. VHF/ZBX mixer box.
82. ZBX control box.
83. ARI.18049 control box.
84. Flight instruments circuit breakers.
85. G.G.S. circuit breaker.
86. Hood motor circuit breaker.
87. Cockpit pressure circuit breaker.
88. Battery isolating switch.
89. Ailerons power control switch.
90. RATO master switch.
91. Ailerons power warning light.
92. Aileron power/aileron manual trim switch.
93. Inner pylon jettison/safe switch.
94. Navigation lights switch.
95. Emergency oxygen bottle manual control.
96. Identification lights switches.
97. Rear booster-pump circuit breaker.
98. Booster-pumps control switch.
99. Booster-pumps warning light.
100. Forward booster-pump circuit breaker.

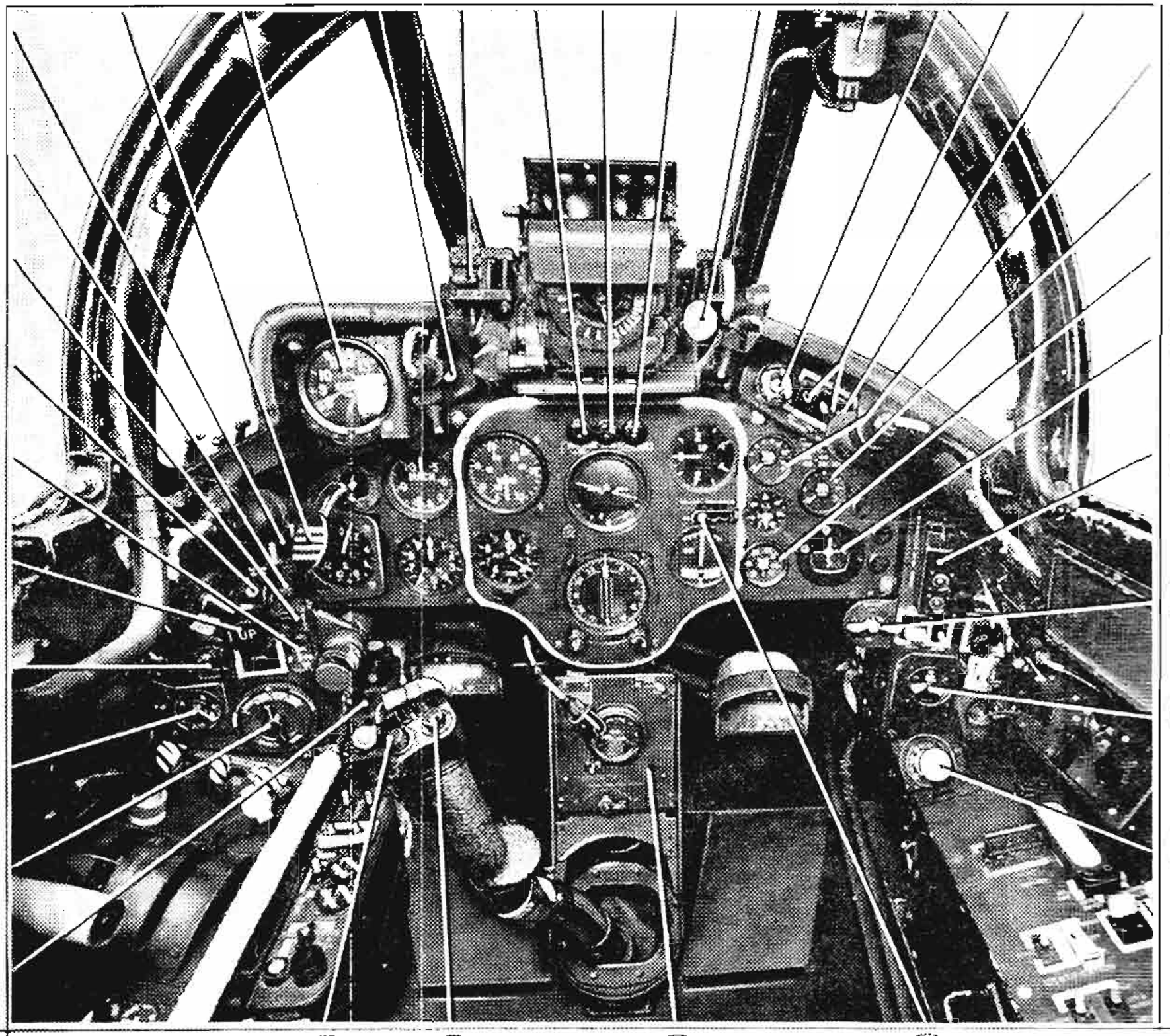


FIG 2

COCKPIT — FORWARD VIEW

FIG 2

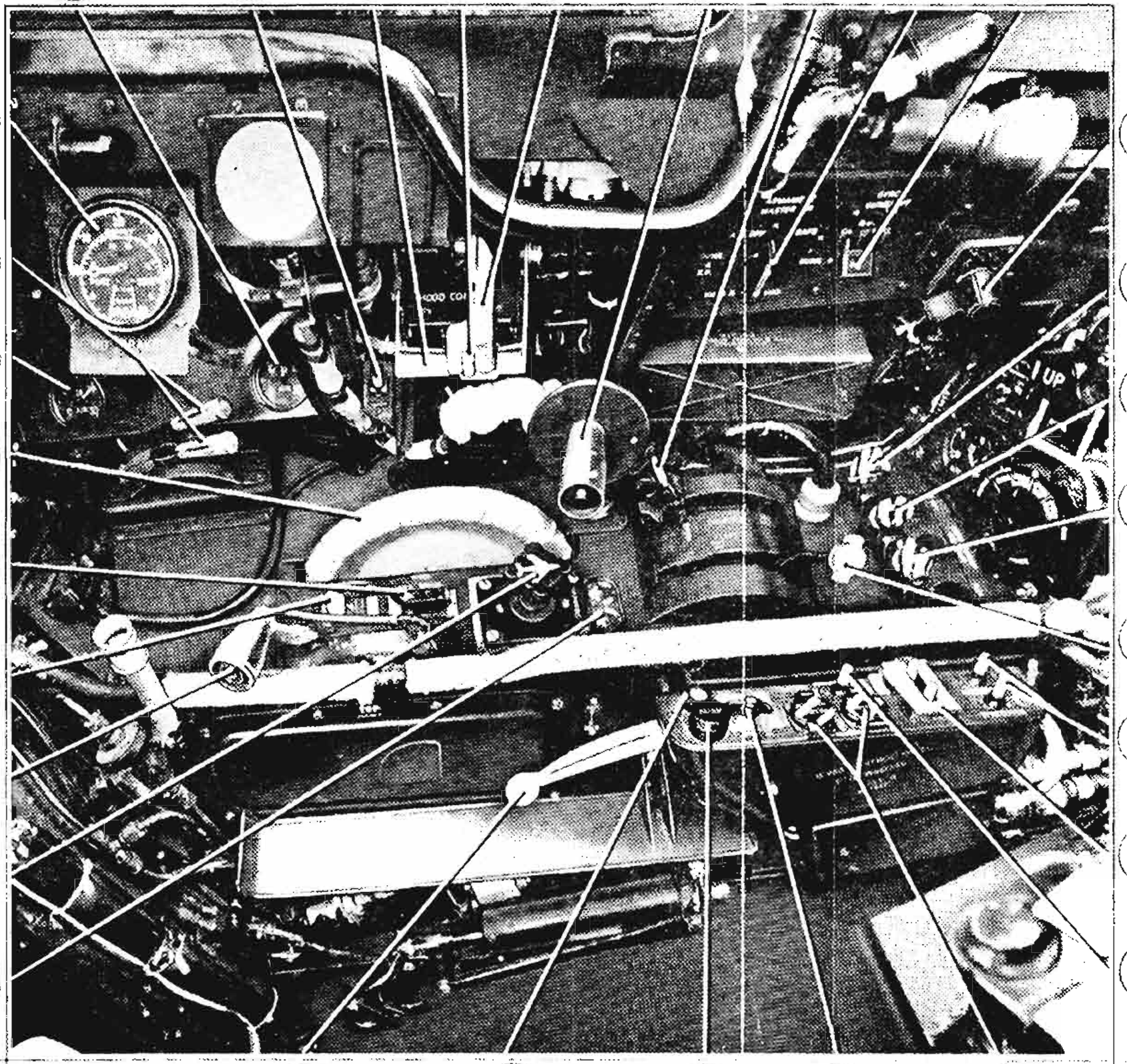


FIG 1

COCKPIT — PORT SIDE

FIG 1

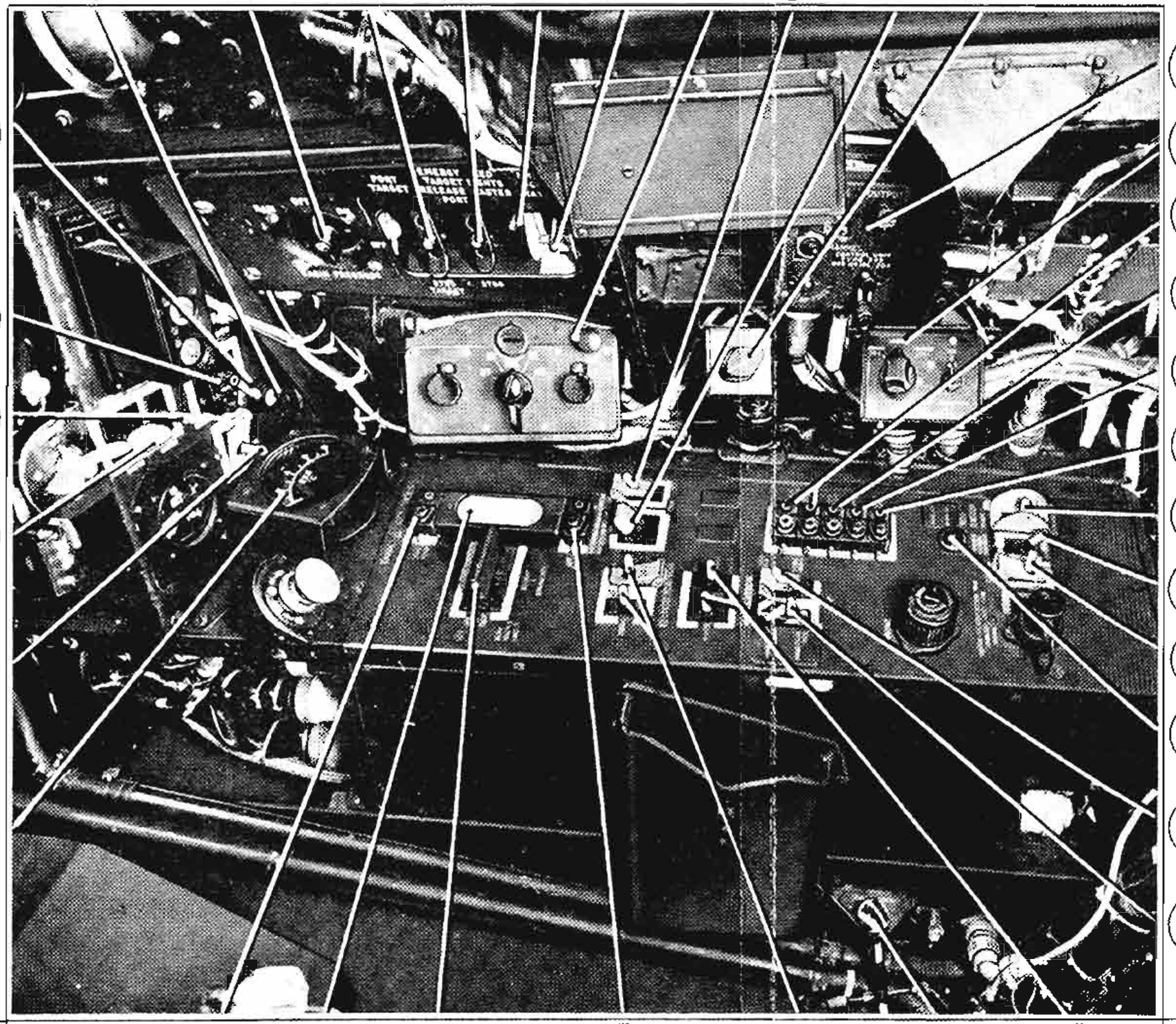


FIG 3

COCKPIT — STARBOARD SIDE

FIG 3

EMERGENCY DRILLS

ACTION IN THE EVENT OF FIRE

1. Close throttle.
2. If light stays on:—
   H.P. and L.P. cocks OFF
   Booster-pumps OFF
   Pressurisation OFF
   Oxygen EMERGENCY
   Airspeed Low as possible
3. Press extinguisher button.
4. If fire goes out, light goes out.
5. Do not relight.
6. Carry out forced landing.
   IF FIRE PERSISTS—ABANDON.

ABANDONING

1. Reduce speed.
2. Lower head and jettison hood.
3. Pull face screen handle.
4. Auto-separation at 10,000 ft. or below.
5. If auto-separation fails:—
   Pull the first D-ring
   Release straps and harness
   When clear of seat pull second D-ring
6. If automatic ejection fails:—
   Pull first D-ring on parachute harness
7. Abandon aircraft as with no ejection seat fitted.

UNDERCARRIAGE EMERGENCY

Select power controls to Manual.
If electric power is available select down on normal control.
Use emergency control.
If one leg has remained fully retracted do not use emergency.

FLAPS EMERGENCY

Fully down *only*, by use of emergency control.

ENGINE FAILURE

(1) Mechanical:—
   Close throttle
   H.P. and L.P. cocks OFF
   Booster-pumps OFF
   Switch off non-essential electrics.
   Carry out forced landing or abandon.

(2) Flame-out:—
   Close throttle.
   H.P. cock OFF
   L.P. cocks ON
   Booster-pumps OFF
   Switch off all non-essential electrics.
   Descend to 20,000 ft. or below.

RELIGHTING

Airspeed (max)	200 K
Altitude (max)	20,000 ft.
Engine starter master switch	ON
Igniter switch	ON
Igniter circuit breaker	IN
Booster-pumps	RELIGHT & EMERGENCY
Throttle	Closed
H.P. pump isolating valve switch	ISOLATE (if fuel suspect)

Press relight button and open H.P. cock together. Keep button pressed for 30 secs. maximum or until r.p.m. or j.p.t. rise. Carefully open throttle and then set booster-pumps switch to NORMAL (unless fuel suspect).

MANUAL REVERSION

Reduce speed below 300 K or 0.8M
Exhaust accumulator.

FLAPLESS LANDING

Approach	130 K
Threshold	115 K

FORCED LANDING

Best gliding speed	180 K
H.P. and L.P. cocks	OFF
Booster-pumps	OFF
Non-essential electrics	Off

When below 10,000 ft. release parachute harness and oxygen leads.

Lower seat, tighten harness, maintain at least	150 K
Round out at	130 K

CHECK LISTS

FINAL CHECKS BEFORE TAKE-OFF

Trim:	
Elevator	1 div. nose down (flaps UP, clean) *or* Neutral (flaps at T.O., clean) *or* 1 div. nose up (flaps at T.O., full drop tanks)
Rudder and Aileron	Neutral (locking catch engaged)
Aileron trim changeover switch (if fitted)	POWER
Airbrakes	Check operation then IN. (selector forward)
Fuel	H.P. and both L.P. cocks fully on. Contents. H.P. pump isolating valve switch as required. Booster-pumps switch NORMAL (lights out) L.P. warning light out.
Wings	Spread and locked. Switch to SPREAD. *Visual indicators flush with wing top surfaces.
Flaps	Check operation. Then as required
Instruments	Set. Pressure head heater ON.
Oxygen	ON, emergency supply connected (Mk. 11—High-flow if going above 25,000 ft.) Mk. 17—100% Flow.
Harness	Tight and locked in rear position.
Hood	If closed, switch forward, clutch release up. If open, switch aft, clutch release up.
Flying controls	Full free and correct movement. Aileron power switch ON, light out.

*This is the only true indication that the wings are locked spread.

ADDITIONAL CHECKS BEFORE CATAPULTING

Throttle	Adjust friction
Flaps	TAKE-OFF
Wheel-brakes	Off, override switch OFF (down)

FINAL CHECKS BEFORE LANDING

Airbrakes	In (selector forward)
Undercarriage	Locked down. Three green lights
Brakes	Off. Check pressure override selector switch OFF (down).
Arrester hook	As required.
Fuel	Contents. Assess A.U.W. and thus deduce correct approach speed. Booster-pumps switch NORMAL. H.P. pump isolating valve switch as required.
Flaps	Fully down on final approach.
Harness	Tight, locked in rear position.
Hood	As required
Cockpit pressure	OFF
G.G.S.	Retracted.

THRESHOLD SPEEDS

At Max. weight (12,100 lb.)	110 K
At light weight (600 lb. fuel)	100 K
Deck landing	105-110 K

INSTRUMENT APPROACH

	R.P.M.	FLAPS	SPEED K.
Pattern	9,500	UP	160
Base leg	9,000	UP	150
Glide path	9,000	TAKE-OFF	115-120

ENGINE LIMITATIONS

	NENE 101		NENE 103	
	R.P.M.	J.P.T.	R.P.M.	J.P.T.
Take-off (15 mins)	12,500 ±100	735°C	12,700 ±100	750°C
Intermediate (30 mins)	12,200	690°C	12,400	725°C
Max. continuous	11,800	635°C	12,000	670°C
Min. approach	7,000	—	7,000	—
Ground idling	2,500 ±100	550°C	2,500 ±100	550°C