De Havilland Mosquito FB6

Pilot's Flight Operating Instructions

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PILOT'S FLIGHT OPERATING INSTRUCTIONS

FOR

de Havilland

MOSQUITO

NOTES TO USERS

THESE notes are complementary to A.P.2095 Pilot's Notes General and assume a thorough knowledge of its contents. **All** pilots should be in possession of a copy of A.P. 2095 (see **A.M.O.** A718/48).

Additional copies may be obtained by the station publications officer by application on Form 294A in duplicate to Command Headquarters for onward transmission to A.P.F.S. (see A.P. 113). The number of the publication must be quoted in full—A.P. 2019E—P.N.

Comments and suggestions should be forwarded through the usual channels to the Air Ministry (TF 2).

MOSQUITO FB 6

AIR MINISTRY
January, 1950

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Pilot's Notes

MOSQUITO FB6

2nd Edition. This edition supersedes all previous issues.

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MOSQUITO FB6

PILOT'S CHECK LIST

(Excluding Checks of Operational Equipment)

	ITEM	CHECK
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	External checks.	
	N.B.—Start at the entrance door and work clockwise around the aircraft.	
2.	Starboard radiator shutter.	Condition and position.
3.	No. 2 engine.	Security of cowlings. Condition of propeller and spinner. Oil and coolant leaks.
4.	Starboard undercarriage.	U/C lock removed and stowed. U/C dust cap on. Extension of shock absorber legs. Condition of snow guard. Tyre for cuts and creep. Valve free. Brake leads secure. Chock in position.
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23.	Fuselage (port side).	Condition.
24.	External aerial.	Condition.

	ITEM	CHECK
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27.	Port aileron.	Condition. Trimmer. External control lock removed.
28	Port identification lights.	Condition.
29	Port navigation light.	Condition.
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	ITEM	CHECK
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	ITEM	CHECK
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	ITEM	CHECK
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107.	Air intakes control (if fitted).	Filter in.
108.	Fuel.	Fullest tanks selected.
109.	Super-chargers.	Mod.
	Reduce speed to 155 knots and check :—	
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111.	R.p.m. control levers.	Set to give 2,850 r.p.m.
	Reduce speed to 130 knots.	
112.	Flaps.	As required.
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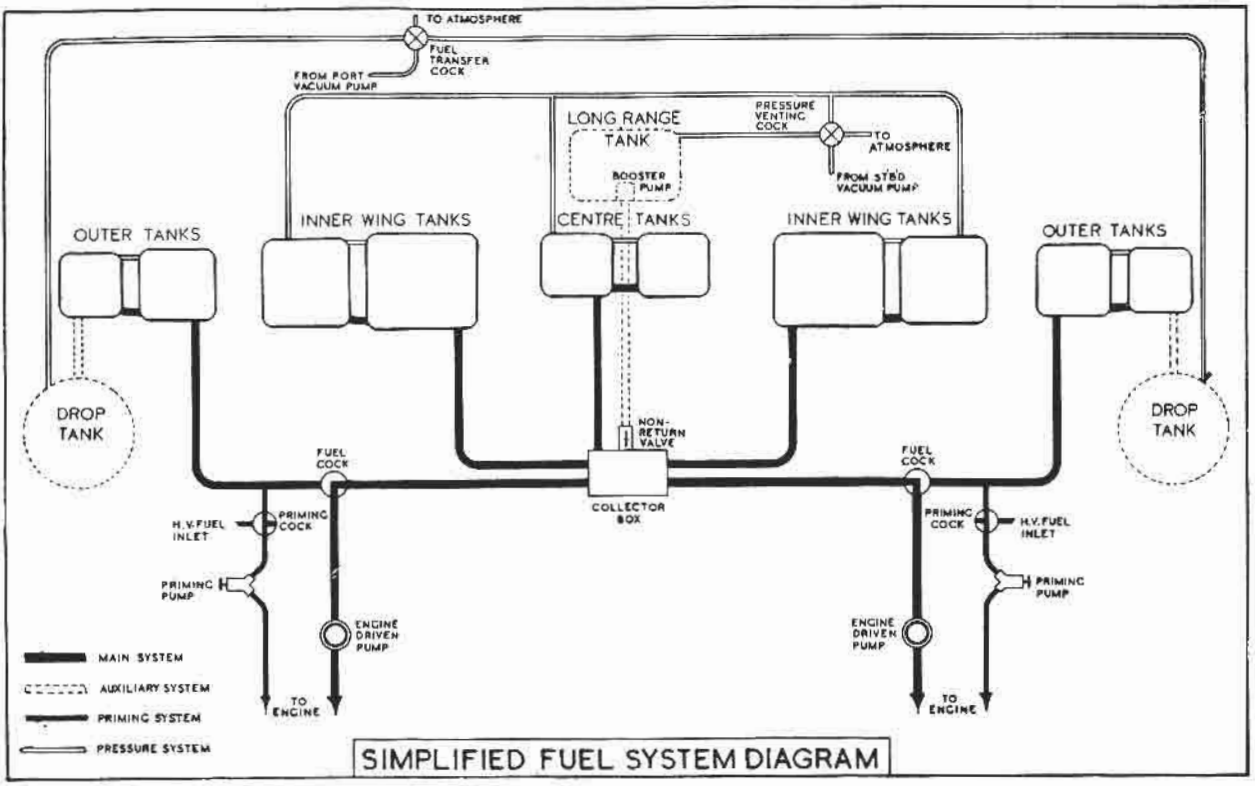


SIMPLIFIED FUEL SYSTEM DIAGRAM

PART I
DESCRIPTIVE

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

(a) The numbers quoted in brackets after items in the text, refer to the illustrations in Part V.

(b) Unless otherwise stated, all speeds quoted are indicated airspeeds.

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

INTRODUCTION

The Mosquito FB Mark 6 is a fighter-bomber aircraft and is powered by two Merlin 23 or 25 engines, driving three-bladed, Hydromatic propellers. There is provision for the alternative carriage of a long-range tank, a bomb or depth charge, or for the simultaneous carriage of R.P. and a 100-gallon drop tank under each wing. An internal bomb load can also be carried.

FUEL AND OIL SYSTEMS

1. Fuel tanks

Fuel is carried in four outer wing tanks, four inner wing tanks, and two centre tanks. In addition a fuselage (long-range) tank can be carried and a drop tank fitted under each wing.

The fuel capacities are as follows :—

MAIN SUPPLY	
Centre tanks	50 gallons
Inner wing tanks	286 gallons
OUTER TANKS	116 gallons
Total	452 gallons
Long-range tank	63 gallons
Wing drop tanks (2 x 100 gallons)	200 gallons
Total fuel capacity	715 gallons

The centre tanks and the inner wing tanks supply both engines through a fuel collector box when the fuel cocks, behind the pilot's seat, are set to MAIN SUPPLY. If a long-range tank is fitted this also supplies both engines through the fuel collector box with the fuel cocks at MAIN SUPPLY and the immersed fuel pump switch (65) on the electrical panel in the " ON " position. When the fuel cocks are set to OUTER TANKS the port outer wing tanks supply No. 1 engine only and the starboard outer wing tanks No. 2 engine only. Fuel is transferred from the wing drop tanks to the OUTER TANKS by air pressure from the port vacuum pump controlled by a transfer cock behind the pilot's seat. If the transfer is not automatic this cock is marked JETTISON TANKS FUEL TRANSFER ; in this case the outer tanks must be nearly emptied before transferring, or fuel will be lost by venting to atmosphere. If Mod. 613 is incorporated, the cock is marked ON FOR AUTO TRANSFER and it may be left on whilst using fuel from the outer tanks. Transfer will then be automatic until the wing drop tanks are empty when the gauge will show a fall in the contents of their respective outer tanks.

A premature fall, in the early part of a flight at altitude, will indicate an interruption of flow ; after an interval which will vary with atmospheric conditions, this will be cured and the fall in the fuel level will stop. The cock should be left ON during an interruption of flow, but must be turned OFF on completion of transfer.

2. **Fuel tank pressurising**

(i) The permanent tanks of the MAIN SUPPLY are provided with automatically regulated pressurising to reduce fuel vaporisation at high altitudes. When the PRESSURE VENTING cock, behind the pilot's seat is ON an aneroid operated valve so controls pressure from the starboard vacuum pump that whilst none is admitted at low altitudes, the amount is progressively increased as height is gained. When it is OFF, all tanks are vented to atmosphere at all altitudes.

(ii) When Mod. 443 is incorporated the pressure venting cock is usually wired in the ON position because the pressurising is then extended to the long-range tank. When this modification has not been incorporated it is advisable to turn the cock OFF whilst actually using the long-range

tank because the immersed fuel pump might not be able to overcome pressurising in the fuel collector box sufficiently to ensure a supply of fuel from the long-range tank.

(iii) Pressurising impairs the self-sealing properties of the tanks and should be turned OFF in emergency. If the cock is locked ON the locking wire can easily be broken.

3. **Immersed fuel pump**

When the long-range tank is fitted an immersed fuel booster pump is provided to feed the fuel to the engine via the collector box. A fuel pressure warning light (21) on the starboard side of the front cockpit coaming, indicates when the long-range tank is nearly empty ; the immersed fuel pump switch must then be turned to OFF.

4. Fuel contents gauges

Three gauges (71, 72, 73) are positioned on the electrical panel. They will indicate as follows when the electrical services switch (20), linked with the ignition switches, is on.

The aft gauge (71) ...	the outer wing tanks
The centre gauge (72)...	the centre tanks and long-range tank when fitted
The forward gauge (73)	the inner wing tanks

5. **Fuel pressure warning lights**

Two fuel pressure warning lights (5) are fitted on the left-hand side of the instrument panel. They light when the pressure drops to 3 lb./sq. in. (These lights will be deleted by Mod. 1243.)

6. **Priming** system

A priming pump is fitted in each engine nacelle and is accessible through a hinged flap on the starboard side. Priming cocks are fitted in each nacelle, and allow fuel to be drawn either from the outer tanks, or from an external supply of high-volatility fuel for cold weather starting.

7 **Oil and coolant systems**

(i) Oil is supplied from two self-sealing tanks of 15 gallons oil capacity and *2 1/2* gallons air space; one in each engine nacelle.

(ii) There are no separate oil cooler controls. Electro-pneumatically operated radiator shutters are fitted at the rear of the combined engine coolant radiator and oil cooler, inboard of each engine. Airflow through the radiator ducts is controlled by these shutters which are operated by two-way switches (15) marked RAD. FLAP-CLOSED (up)—OPEN (down). Thermostatic and viscosity valves in both coolant and oil cooler systems respectively, ensure rapid "warming up" to pre-determined temperatures.

MAIN SERVICES

S. Hydraulic system

(i) Two engine-driven pumps, one on each engine, supply hydraulic pressure for the operation of the :—

Undercarriage and tailwheel
Flaps
Bomb doors.

The system will function on one pump, but only at a reduced rate.

(ii) A handpump for operating all the services through the normal system, when the engine pumps are not running is mounted in a socket (55) beneath the pilot's seat. **The** detachable handle is stowed on the cockpit door. **The** approximate time to lower the undercarriage by hand-pump is four minutes.

(iii) The handpump may also be used to operate the separate emergency undercarriage lowering system, when the emergency selector valve, marked PUSH FOR EMER-GENCY, on the right of the pilot's seat is pushed down.

9. Pneumatic system

(i) An air compressor on No. 1 engine charges an air bottle for the operation of the brakes and guns, and the electro-pneumatic rams for :—

Radiator shutters
Automatic supercharger gear change
Carburettor air-intake filter control.

(ii) The available pressure is shown on the pneumatic system and brakes triple pressure gauge (36) and should record 200 lb./sq. in. in flight. All services except the brakes are cut off by a pressure maintaining valve if the supply falls below 150 lb./sq. in.

(iii) Two vacuum pumps, one driven by each engine, together operate the flight instruments. If either pump should fail it is automatically isolated from the suction system. Each pump can be proved on the ground by alternatively starting the port and starboard engine first and checking that the artificial horizon erects properly.

10. **Electrical system**

A generator on No. 2 engine charges a battery which supplies electrical power at 24 volts for :—

Automatic superchargers
Air intake filters
Radiator shutters
Guns
Radio (Gee 11, G.P. H.F. communication set, V.H.F., I.F.F.)
Instrument and cockpit lighting
Air recognition, identification, navigation lights and landing lamp.
Engine starters and booster coils
Immersed fuel pump
Feathering pump motors
Undercarriage warning lights and horn
Oil dilution valves
Fuel pressure warning lights
Fire-extinguishers
Windscreen wiper
Pressure-head heater
Cine-camera
Reflector gunsight
Bomb selection, fuzing and release gear
R.P. release.

A warning light (60) on the electrical panel shows when the generator is not delivering current. On the ground with the engine stopped, the light will be on so long as the

aircraft battery is connected. The current consumed **is** negligible.

A ground starter battery socket is provided on the port side of rear fuselage.

AIRCRAFT CONTROLS

11. Flying controls

The flying controls are conventional and the rudder pedals are adjustable for reach.

12. Flying controls locking gear

The rudder pedals are locked by a spool which fits between them and is secured by a wing nut. The **spool** is connected to the control column locking tube by a cable so that one cannot be removed without the other. Controls are locked in the neutral position. The gear is stowed in the fuselage opposite the rear hatch. It should be ensured that the locking pins are attached to the gear.

13. Trimming tab controls

The elevator trimming tab control is on the left of the pilot's seat ; the indicator (42) is on the cockpit port wall. The rudder trimming tab control and indicator (19) are mounted on the front cockpit coaming.

The aileron trimming tab control and indicator are mounted on the lower right-hand side of the instrument panel. All trimming tab controls work in the natural sense.

14. Undercarriage

(i) The undercarriage selector lever (32) has a safety catch which must be released before UP can be selected. The selector should always be moved smartly to the UP or DOWN positions, as it may become locked if it is moved slowly.

(ii) The selector should return automatically to neutral when the UP or DOWN operation is completed. If the lever does not return when it is certain that the operation is complete, it should be returned by hand. If the lever re-

turns prematurely, and the undercarriage indicator shows that the wheels are not locked UP or DOWN, the selector lever should be held UP or DOWN for not more than 5 seconds. This will occur only when the system is **not** properly adjusted.

(iii) In cold weather before landing, the system should be exercised a few times by alternatively selecting UP or DOWN ; owing to the hydraulic oil congealing, when the undercarriage selector is put DOWN the main wheels may come down and the selector return to neutral before hydraulic pressure reaches the tailwheel jack.

(iv) It is not desirable to hold the selector DOWN for longer than 5 seconds as this subjects the lines to high pressures.

15. **Undercarriage position indicator**

(i) The undercarriage position indicator (38) operates when the electrical services switch is on.

(ii) The indicator lights are fitted with dimmer screens for night flying. Indications are :—

Main wheels locked up ... ... No lights
Main wheels locked up but throttles less than 1/4 open ... ... 2 red lights
Main wheels between UP and DOWN 2 red lights
Main wheels locked down ... ... 2 green lights

When the main wheels are lowered, the red lights do not go out until the down locks are engaged.

(iii) There is no tailwheel indicator.

16. **The undercarriage warning horn**

The undercarriage warning horn sounds when the main wheels are not locked down and the throttles are less than 1/4 open.

17. **Undercarriage ground locking**

(i) Ground locking caps are stowed in a bag on the rear bulkhead of each nacelle, and should be fitted after landing in place of the dust caps which cover the end of **the** locking latches.

(ii) If the aircraft is taken off with the locking caps on, and an attempt is made to retract the undercarriage, the tailwheel only will retract; therefore, the undercarriage

selector lever should be moved to the DOWN position, allowed to return to neutral and then held down for 5 seconds before landing to ensure that the tailwheel is down.

18. **Flaps control and indicator**

Operation of the flaps is controlled by the lever (29) marked F to the right of the undercarriage selector lever. A safety catch must be pushed to the right before flaps DOWN can be selected. The selector lever should return automatically to neutral on completion of a full operation. Any flap angle up to 45 ° can be obtained by returning the lever to neutral when the desired angle is reached according to the position indicator (37). The maximum flap angle is 45° although the gauge is marked up to 70°.

19. **Wheel brakes**

The brakes control lever (46) and parking catch are on the control column. Differential braking is afforded by means of a relay valve connected to the rudder pedals. The pressure at each brake should be between 80 to 100 lb./sq. in.

ENGINE CONTROLS

120. Throttle controls

The black friction nut is for the throttles: the (larger) white one is for the propeller levers.

Normally the throttles can be pushed forward to the stops only. When the small catches on the levers are squeezed the throttles can be pushed fully forward.

Merlin 25 engines give 4-12 lb./sq. in. boost at the stops and +18 lb./sq. in. when fully forward ; there is no cut-out. Merlin 23 engines may still be fitted. They give +9 lb./sq. in. at the stops and +12 lb./sq. in. at the fully forward position. If the boos control cut-out is pulled, +14 lb./sq. in. will be obtained in low gear.

De-rated engines of either mark give +9 lb/sq. in.boost at the stops and +12 lb./sq. in. at the fully forward position, and do not have a cut-out.

21. **Mixture and slow running cut-out controls**

(i) S.U. carburettors are fitted and mixture is automatically controlled by the boost pressure ; an economical mixture is obtained when this is less than +7 lb./sq. in.

(ii) Spring loaded slow running cut-out controls, mounted above the fuel cock controls should be pulled out to stop the engines, after which they should be released smartly.

22. **Propeller controls**

The r.p.m. control levers (49) which vary the governed pitch from 3,000-1,800 r.p.m. are fitted on the side of the engine controls box. The feathering pushbuttons (25) are on the right-hand front panel. The friction control lever (50) is the larger white knob on the engine controls box.

23. **Superchargers control**

When the superchargers gear change switch (51) is set to MOD, the superchargers will remain in low gear at **all** altitudes. When this switch is set to AUTO the electro-pneumatic rams are controlled by an aneroid, and will automatically engage high gear when climbing, at approximately the following heights :

Merlin 23—8,750 ft.
Merlin 25—7.000 ft.

A.L.1 Para. 23

These heights are the correct supercharger gear change heights only when using maximum power (operational necessity). When using low power settings, the selection of high gear should be carried out by switching to AUTO as recommended in para. 41. When descending in AUTO, low gear will be engaged at slightly lower altitudes than those quoted above.

Failure of the electrical or pneumatic system will cause the superchargers to remain in, or return to, low gear.

24. **Radiator shutters**

The radiator shutters are controlled by two switches (15) which operate electro-pneumatic rams. It is not possible to set the shutters at intermediate positions between fully open and shut.

25. **Carburettor air-intake filters**

Air-intake filters are provided. They are controlled by a switch (16) beside the radiator shutter switches, or when Mod. 862 is incorporated by two pushbuttons fitted below the coaming on the right-hand side of the instrument panel when the filters are controlled manually by a *projecting* pushbutton marked FILTER OUT and a *flush* pushbutton marked FILTER IN. The relay control is interconnected with the undercarriage so that when the undercarriage is down the filter is automatically brought into operation irrespective of the position of the push-

buttons, unless the FILTER OUT pushbutton is kept pressed. After take-off and well clear of the dust-laden zone the projecting pushbutton should be pressed in for FILTER OUT.

If required FILTER IN may be selected at any time during flight, though normally FILTER OUT should be used.

OPERATIONAL CONTROLS

26. **Bomb doors**

The bomb doors selector lever (34) marked B on the left of the undercarriage selector lever, should return automatically to neutral on completion of a full operation. A warning light (26) on the bomb control panel indicates when the bomb doors are fully open.

27. **Bomb selection, fusing and release**

(i) The panel on the right-hand side of the instrument panel provides the switching arrangements for the fuselage bomb, wing bombs and wing drop tanks. The switch (28) at the top marked BUTTON CHANGEOVER CAMERA and BOMBS or TANKS permits the pushbutton (45) on the control column to be used for operating either the cine-camera or the bomb release. The bombs cannot be selected or fused until the BUTTON CHANGEOVER has been moved to BOMBS or TANKS.

For emergency bomb release see para. 61.

28. **Cine-camera operation**

The cine-camera master switch (61) must be ON and the button changeover switch set to CAMERA before the camera can be operated by the release button or by pressing either of the gun-firing triggers.

29. **R.P. and gun controls**

(i) Before the guns can be fired the gun master switch (33) must be set to FIRE.

The 20 mm. guns are fired by a forefinger operated trigger, the machine guns by a thumb-operated trigger (44)

both on the control column. The gun heating control is on the right of the observer's seat. Minimum pneumatic pressure required for operation is 200 lb./sq. in.

(ii) The R.P. PAIRS—SALVO switch is mounted adjacent to the gunsight and should be switched to the required position before the MASTER SWITCH is turned ON. The MASTER SWITCH is on the R.P. Auto-selector unit, which is mounted on the cockpit port wall aft of the engine controls box. The firing pushbutton is mounted on No. 2 engine throttle lever.

COCKPIT EQUIPMENT

30. **Oxygen**

A Mk. 11B oxygen regulator (35) is fitted together with a flow selector switch and indicator.

31. **Heating**

The cockpit heat control is behind the pilot's seat, and is rotated forward to permit hot air from the port coolant radiator to enter the cockpit.

32. **Cooling**

There are two adjustable ventilators (24) by means of which cool air can be admitted to the cockpit.

33. **Windscreen wiper and de-icer**

The windscreen wiper should not be used on a dry screen, it may injure the surface. When not in use make sure that the rheostat (78) is turned fully off, otherwise, current may be wasted.

A windscreen de-icer pump is mounted beneath the aileron trimming tab control.

34. **Lighting**

Three floodlights with adjacent rheostats, light the instrument panel and compass.

They are controlled by separate dimmer switches.

There is a cockpit roof light, and provision is also made for UV/red and emergency lighting.

35. Night flying screens

The generator (60) and fuel pressure (5) warning lights are fitted with dimmer screens. When flying by day, these screens must be opened ; otherwise, indications **will** not be noticed.

PART II
HANDLING

36. Management of the fuel system

(i) Start the engines on the outer tanks, warm up on **the** main tanks, taxy and take-off on the fullest tanks.

(ii) Use of the outer tanks.

(a) Do not rely on outer tanks when flying at low altitudes ; their capacity is small and the gauges diminish in accuracy as the fuel level falls.

(b) The outer tanks are pressurised only when transfer of fuel is taking place from the wing drop tanks. When wing drop tanks are not used vaporisation may cause engine cutting at high altitudes particularly in tropical climates.
Interruptions of flow are most likely to take place in the early part of a flight at high altitude. When at dispersal every effort should be made to shield **the** aircraft from the direct rays of the sun, as the fuel should be kept as cool as possible.

(c) Engine cutting may occur during evasive action, at high power at altitude, and whenever the tanks are less than half full.

(d) It is not possible to cross-feed from the outer tanks should one engine fail and they should therefore be used first. When they are nearly empty, change to the main supply.

(iii) Use of the wing drop tanks

(a) The contents of both wing drop tanks are transferred by pressure from the exhaust side of the port vacuum pump. Failure of this pump will be masked by **the** automatic isolation valve, unless failure of No. 1 engine makes it obvious. Failure of this pump will only be revealed by the non-transfer of the contents of the wing drop tanks when transfer is selected.

(b) The contents of the wing drop tanks should be transferred as early as possible to avoid loss of fuel if they should have to be jettisoned. In the event of

FINAL CHECKS FOR TAKE-OFF

TRIM	ELEV. ...	NOSE HEAVY AS REQUIRED
	RUD. ...	SLIGHTLY RIGHT
	AIL. ...	NEUTRAL
PROPS.	...	MAX. RPM.
FUEL	...	COCKS FULLY ON
FLAPS	...	UP OR 15°
RADIATORS	...	OPEN

FINAL CHECKS FOR LANDING

FUEL	...	CHECK TANKS
RADIATORS	...	OPEN
BRAKES	...	OFF
		CHECK PRESSURES
WHEELS	...	DOWN AND LOCKED
PROPS.	...	2,850 RPM ON FINAL
FLAPS	...	FULL ON FINAL

failure of the port vacuum pump, fuel cannot be transferred, nor can it be cross-fed, in the event of engine failure ; therefore, as soon after take-off as convenient turn on the transfer cock. When the wing drop tanks have been emptied, shown by a fall in the contents of the outer tanks, turn off the transfer cock.

Continue on the outer tanks until they are empty, then change to main supply.

(c) If automatic transfer is not provided, sufficient fuel must be used from the outer tanks before attempting to transfer, or fuel may be lost through the atmospheric vents. To transfer fuel, change to main supply and turn on the transfer cock. When the outer tanks are full, turn off the transfer cock and revert to outer tanks. Repeat the sequence until the wing drop tanks are empty.

(iv) *Use of the long-range tank*

Select main supply and turn on the immersed fuel pump. As soon as the warning light comes on the immersed fuel pump should be switched off.

37. **Starting and warming up the engines**

(i) After carrying out the external, internal and cockpit checks laid down in the Check List, confirm :—

Main fuel cocks	Outer tanks
Throttles	*1/2* in. open
R.p.m. control levers	Maximum r.p.m position
Superchargers ...	Mod. (low gear)
Radiator shutters	CLOSED
Pressure venting cock.	ON
Fuel transfer cock	OFF
Immersed fuel pump switch	OFF
Bomb doors	Shut, selector neutral

(ii) If the engines are to be started from an external source, have a ground starter battery plugged in, and then for each engine in turn :—

(iii) The ground crew should work the priming pump until fuel reaches the priming nozzles; this can be judged by a sudden increase in resistance.

(iv) Switch on the ignition and press the starter and booster-coil pushbuttons. Turning periods must not exceed 20

seconds with 30 second intervals.

(v) The ground crew should work the priming pump as rapidly and vigorously as possible while the engine is being turned,

(vi) At air temperatures below freezing it will probably be necessary to continue priming after the engine has fired and until it picks up on the carburettor.

(vii) As soon as the engine is running satisfactorily, release the starter and booster-coil pushbuttons and instruct the ground crew to screw down the priming pump and remove the ground starter battery if used.

(viii) After the oil pressure has become steady, open the throttle slowly and warm up at 1,200 r.p.m.

(ix) While warming up, items (86) to (90) of the Check List should be carried out.

NOTE.—(a) It is recommended that the engines be started in a different order each time so **that the** vacuum pumps can be checked for **correct** functioning.

(b) When the starboard engine is opened up, check that the generator is charging. The warning light should be out.

38. Exercising and testing

(i) Warm up to 15°C. oil temperature and 40°C. coolant temperature, and then for each engine in turn :—

(ii) At warming up r.p.m. test each magneto as a precautionary check and open the radiator shutters.

(iii) Open up to the static boost reading (zero under standard atmosphere conditions) and check the operation of the supercharger by setting the switch to AUTO and having the ground crew press the test pushbutton in each engine nacelle. R.p.m. should drop slightly and boost should rise when the change to high gear is made.

(iv) At the same boost, exercise and check the operation of the constant speed unit by moving the r.p.m. control lever over the whole range at least twice. Return the control lever to the maximum r.p.m. position, then check that the r.p.m. are within 50 of those normally obtained.

(v) At the same boost test each magneto. If the single ignition drop exceeds 150 r.p.m. but there is no undue vibration.

a full power check should be carried out; if there is marked vibration the engine should be stopped and the cause investigated. The full power check may also be carried out after repair, inspection other than daily, when the ignition drop at zero boost exceeds 150 r.p.m. or at the discretion of the pilot. If the checks at the static boost are satisfactory no useful purpose will be served by a full power check.

(vi) The full power check should be carried out as follows :— Open the throttle fully and check the take-off boost and r.p.m. Throttle back until a drop in r.p.m. is apparent and test each magneto. If the single ignition drop exceeds 150 r.p.m. the aircraft should not be flown.

(vii) After completing the checks either at the static boost reading or at full power, steadily move the throttle to the fully closed position and check the minimum idling r.p.m. Then open up to 1,200 r.p.m.

39. **Taxying**

Carry out items (93) and (94) in the Pilot's Check List.

40. Take-off

(i) Carry out items (95) to (105) in the Pilot's Check List.

(ii) Taxy forward a few yards to straighten the tailwheel.

(iii) Open the throttles slowly, checking any tendency to swing by coarse use of the rudder and by differential throttle movement. There is little tendency to swing if the engines are kept synchronised.
The travel of the throttle levers is very short for the power obtained.
Coarse use of the throttles will aggravate any tendency to swing.

(iv) When comfortably airborne, brake the wheels and raise the undercarriage, check that the undercarriage locks up; if it does not hold the selector lever up for five seconds.

(v) Safety speed at a weight of approximately 17,000 lb. flaps up or 15° down at +9 lb./sq. in. boost is 155 knots. At + 18 lb./sq. in. boost it is 170 knots. These speeds however, may vary considerably with individual aircraft.

(vi) Before raising the flaps, if used, trim the aircraft slightly tail heavy.

41. Climbing

(i) The speed for maximum rate of climb is 150 knots.

(ii) Climb in low gear at 2,850 r.p.m. and +9 lb./sq. in. boost. When the maximum obtainable boost has **fallen to** + 7 lb./sq. in., change to AUTO. Above 18,000 ft. decrease the airspeed by 2 knots per 1,000 ft.

(iii) When climbing for maximum range, climb in low gear at 2,650 r.p.m. and +7 lb./sq. in. boost, using the airspeeds recommended above. When the maximum obtainable boost has fallen to +4 lb./sq. in. set the supercharger gear change switch to AUTO and re-adjust the throttles. Above 18,000 ft. increase power to +9 lb./sq. in. and 2,850 r.p.m. and reduce airspeed as recommended. Although less fuel is used to reach a given altitude by climbing at high power the total fuel used and the **time** taken on the subsequent cruise is the same, whether **the** aircraft is climbed at 2,650 r.p.m. and +7 lb./sq. **in.** boost or 2,850 r.p.m. and +9 lb./sq. in. boost.

(iv) When climbing with a boost setting of less than + 9 lb./sq. in. the automatic boost control cannot open the throttle valves fully and the boost will begin to fall off before **full** throttle height is reached ; the throttle levers should be progressively advanced to the gate to maintain the desired boost.

(v) For operational necessity at any altitude, select AUTO and 3,000 r.p.m. and move the throttles fully forward (see para. 20).

42. General flying

(i) *Stability*

Stability about all axes is satisfactory, but with the C.G. aft longitudinal stability deteriorates on the climb.

(ii) *Changes of trim*

Undercarriage up ...	Slightly nose up
Undercarriage down ...	Nose down
Flaps up	Strongly nose down
Flaps down	Nose up
Radiator shutters open	Nose up
Radiator shutters closed	Nose down
Bomb doors open ...	Nose up slightly
Bomb doors closed ...	Nose down slightly

(iii) *Controls*

The controls are light and effective and manoeuvrability is good. The rudder should not be used violently at high

speeds. When two-tier R.P. or rails are carried, aileron control is poor at low speeds, i.e., during take-off and approach to land.

(iv) *Flying at reduced airspeeds*
Speed should be reduced to 175 knots, flaps lowered 15° and the r.p.m. controls set to give 2,650 r.p.m. Speed may then be reduced to 130 knots.

43. **Stalling**

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

Power off	18,000 lb.
Undercarriage and flaps up	105
Undercarriage and flaps down	95-100
Power on under typical approach conditions	90-95

(ii) Warning of the approach of the stall is given by pronounced buffeting of the control surfaces, the onset of which can be felt some 10 knots before the stall itself. At the stall the aircraft pitches, the A.S.I, fluctuates and the nose drops gently. There is little tendency for the wing to drop unless the control column is held back.
Recovery is easy and normal in all cases.

44. Cruising

(i) For any required airspeed, the maximum weak mixture boost (+ 7 lb./sq. in.) together with the lowest practicable r.p.m. provide the most economical conditions.

Para. 44 (ii) I (ii) When cruising at low r.p.m. the engines should be cleared every 30 mins. at + 12 lb./sq. in. boost and 2,850 r.p.m. for 30 secs.

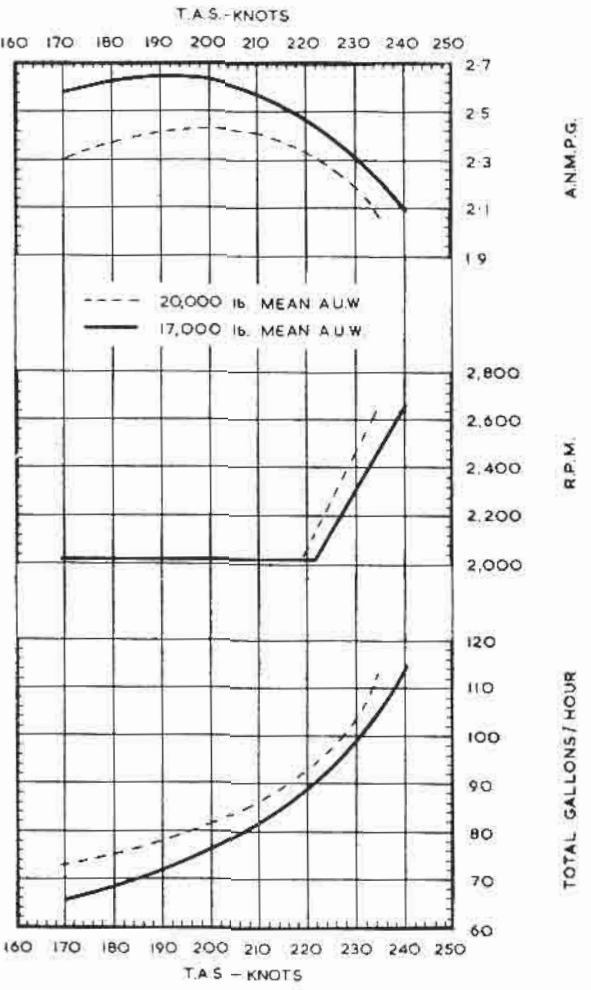
(iii) At any height the speed for maximum range is 170 knots
A21 at a weight of 17,000 lb. but below 10,000 ft. this speed can only be obtained at an uneconomical boost setting, even when using minimum r.p.m. Speed should therefore be increased to approximately 200 knots,

(iv) Fly with the supercharger gear change switch in the **MOD** position, unless the recommended airspeed cannot be obtained without exceeding 2,650 r.p.m., when high gear should be engaged by switching to AUTO.

45. **Flight planning charts**

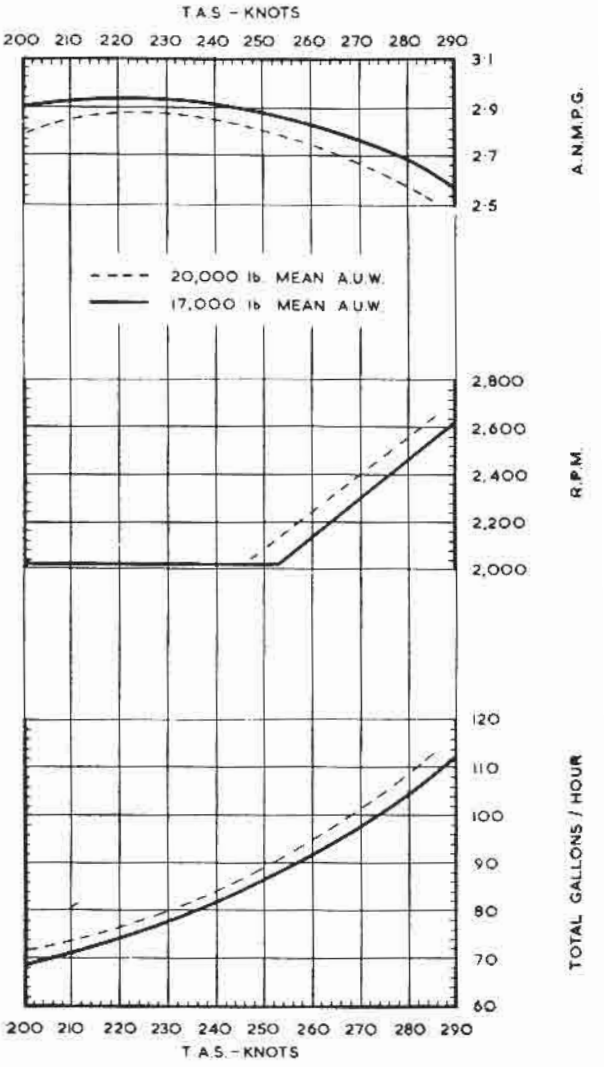
The recommended cruising speeds ANMPG and **GPH** curves for a mean weight of 17,000 lb. and 20,000 lb. at sea level, 10.000 ft. and 20,000 ft. in low gear and at 25,000 ft. in high gear are on pages 30 to 33.

FLIGHT PLANNING CHARTS.

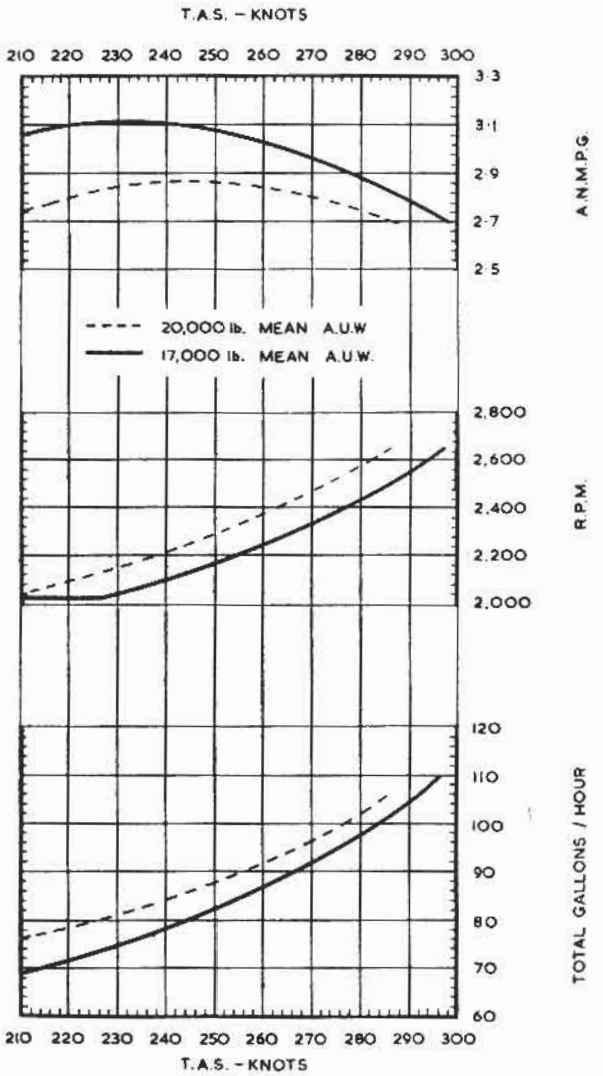


SEA LEVEL LOWGEAR

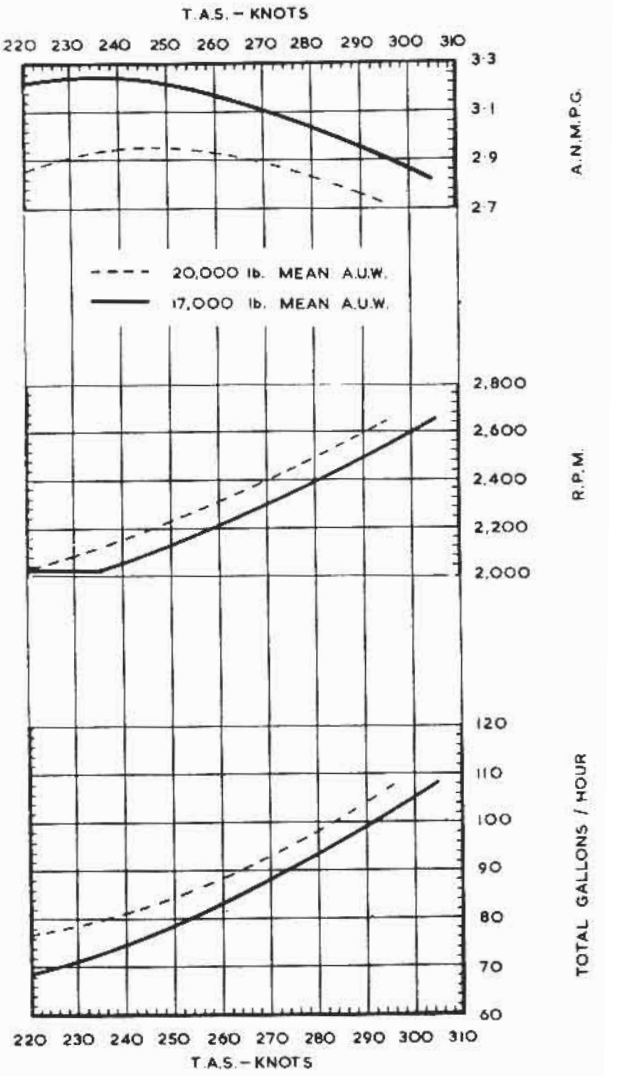
PART II—HANDLING



10,000 FT. LOWGEAR



20,000 FT. LOWGEAR



25,000 FT. HIGHGEAR

50. **Oil dilution**

(i) Adjust the oil level in the tanks to 12 1/2 gallons.

(ii) To ensure a cold start at the following temperatures the oil should be diluted for the times quoted below :

Between - 10°C. and - 15 °C. . . . . 1 minute

Between - 15°C. and -26°C. . . . . 2 minutes

(iii) During the next start after 2 minutes' dilution the minimum partial boiling-off period at 2,000 r.p.m. is 10 minutes. After 1 minute dilution no special partial boiling-off precautions are necessary.

PART III
LIMITATIONS

51. **Engine data Merlin 23 and 25**

The principal engine limitations are as follows :-

Merlin 25

	Super-charger gear	R.p.m.	Boost lb./sq. in.	Temp. °C. Coolant	Oil
MAX. TAKE-OFF	Low	3,000	+ 18*		
INTERMEDIATE 1 HR. LIMIT	Low / High	2,850	+ 9	125	90
MAXIMUM CONTINUOUS	Low/ High	2,650	+ 7	105(115) t	90
OPERATIONAL NECESSITY 5 MINS. LIMIT	Low / High	3,000	+ 18*	135	105

*May not be used at r.p.m. below 2,850.

t The temperature shown in brackets may be used if necessary for short periods only.

NOTE.— In some aircraft Merlin 23 engines will still be installed. The difference as regards operational limitations from those for the Merlin 25 quoted above are as follows :—

MAX. TAKE-OFF . . . . . + 14 lb./sq. in.

OPERATIONAL NECESSITY L) 3,000 + 14 lb./sq. in.*
5 MINS. LIMIT H) r.p.m. + 16 lb./sq. in.*

* Obtainable by use of the boost control cut-out.

Merlin 23 and 25

OIL PRESSURE

MINIMUM IN FLIGHT. . . . . 30 lb./sq. in.

MINIMUM TEMPERATURE FOR TAKE-OFF

OIL +15°C.
COOLANT +40°C.

PART III — LIMITATIONS

52. **Flying limitations**

(i) Deliberate spinning is prohibited and an incipient spin should be checked by immediate recovery action.

Although aerobatics are permitted at weights below 19,100 lb. without bomb load, underwing stores or wing drop tanks, they are not recommended owing to the possibility of damaging the special equipment.

(ii) The controls are light and effective and care should be taken to avoid excessive accelerations in turns and recovery from dives. At high speeds violent use of the rudder and large angles of yaw must be avoided.

(iii) *Maximum weights*

Take-off and gentle manoeuvres	20,500 lb.
All forms of flying	19,000 1b.
Landing	20,500 lb.

(iv) Maximum speeds in knots are :

(a) Without underwing stores or with 2 x 250 or 500 lb. G.P. bombs with standard wing bomb fairings.

(b) With 2 x 100 gal. wing drop tanks.

(c) With underwing R.P. or depth charges.

(d) With underwing stores.

	(a)	(b)	(c)	(d)
Sea level to 10,000 ft.	370	330	350	305
10,000 ft. to 15,000 ft.	350	330	350	305
15,000 ft. to 20,000 ft.	320	320	320	305
20,000 ft. to 25,000 ft.	295	295	295	295
25,000 ft. to 30,000 ft.	260	260	260	260
30,000 ft. to 35,000 ft.	235	235	235	235

Bomb doors open	305
Undercarriage down ...	155
Flaps not more than 25° down	**175**
Flaps fully down	**130**

(ii) A normal circuit can safely be made irrespective of which engine has failed. The checks before landing should be carried out as for a normal landing, but it should be remembered that the undercarriage will take longer to lower on one engine—approximately 30 seconds at 2,850 r.p.m. —and, owing to its high drag, height will be lost once it has started to lower.

(iii) When across wind, flaps may be lowered 15° and the live engine used carefully to regulate the rate of descent. Speed should not be allowed to fall below 135 knots until it is clear that the airfield is within easy reach ; flaps may then be lowered further as required and power and speed reduced as height is lost, aiming to cross the airfield boundary at the speeds quoted for an engine assisted landing.

58. **Going round again on one engine**

Going round again is only possible if the decision is made while ample height remains and before more than 15° of flap is lowered. The height is required in order to maintain the speed above the critical speed, for the high power necessary, while the undercarriage and flaps are retracting. When the decision to go round again has been made:—

(i) Ensure that the speed is not less than 135 knots, and then increase power on the live engine to +9 lb./sq. in. boost and 2,850 r.p.m.

(ii) Raise the undercarriage.

(iii) Increase speed to 140-150 knots.

(iv) Raise the flaps and re-trim.

(v) If the engines are not de-rated, power higher than +9 lb./ sq. in. should only be applied carefully and within the limits of rudder control.

(v) (a) Firing of RP is prohibited whilst carrying drop tanks and until at least one minute after they have been jettisoned.

(b) Wing drop tanks should only be jettisoned in level flight without yaw, at speeds between 175 and 260 knots.

PART IV
EMERGENCIES

53. **Feathering**

(i) Close the throttle.

(ii) Hold the pushbutton in only long enough to ensure **that** it stays in by itself, then release it so that it can spring out when the feathering is complete. If it does not spring out, it must be pulled out.

(iii) Turn off the fuel cock.

(iv) When the engine has stopped, or nearly stopped, switch off the ignition and close the radiator shutter.

54. **Unfeathering**

(i) Set the throttle slightly open and the r.p.m. control lever fully back, and then switch on the ignition.

(ii) Hold the pushbutton in until r.p.m. rise to 800-1,000 and ensure that it springs out fully.

(iii) Turn on the fuel.

(iv) If the propeller does not return to normal constant-speed operation it must be feathered and unfeathered again, releasing the pushbutton at slightly higher r.p.m.

(v) It is advisable to unfeather at speeds below 175 knots to avoid risk of engine overspeeding.

(vi) Idle the engine at approximately 1,800 r.p.m. until **the** temperatures reach the minimum for opening up.

PART I V —EMERGENCIES

55. **Engine failure during take-off**

(i) The handling characteristics of individual aircraft differ considerably according to age and load. Except in cases where it is known to be less ; at approximately 17,000 lb., safety speed should be assumed to be 155 knots at + 9 lb./ sq. in. boost and, if the engines have not been de-rated 170 knots at + 18 lb./sq. in. boost.

(ii) If safety speed has been attained, the aircraft will climb away on one engine at climbing power at about 135-140 knots provided that:—

(a) The propeller of the failed engine is feathered and the radiator shutter closed.

(b) The flaps are fully up.

(iii) The drag of a windmilling propeller is very high and unless feathering action is taken immediately, control can only be maintained at the expense of a rapid loss in height.

(iv) The aircraft accelerates slowly to the safety speed at + 18 lb./sq. in. boost. If high power is used for take-off, it is recommended that climbing power is used as soon after take-off as is possible.

56. **Engine failure in flight**

(i) Close the throttle and feather the propeller of the failed engine.

(ii) Open the radiator shutter and keep a careful watch on the temperature of the live engine.

(iii) At full load, height can be maintained on either engine up to 12,000 ft. using climbing power at about 150 knots.

57. **Single-engine landing**

(i) While manoeuvring with the flaps and undercarriage up, a speed of 140-150 knots should be maintained ;

59. **Undercarriage and flaps emergency operation**

(i) If the undercarriage has lowered but not locked down :

(a) Re-select DOWN, check that the selector lever returns to neutral, and check the position of the undercarriage by the indicator and warning horn.

(b) If the undercarriage is still not locked down, but the selector lever springs back to neutral, this indicates functioning of the hydraulic pumps, but no positive operation of the undercarriage down locks.
Leave the selector in the neutral position until the flaps have been lowered, then take every opportunity of holding the undercarriage selector in the **DOWN** position. After landing hold the selector in the DOWN position until the units can be locked by the ground crew.
Until this has been done, avoid raising the flaps, taxying, turning or using the brakes.

(ii) If the indicator fails to show that the undercarriage is locked down, and the selector lever does not spring back to neutral :

(a) Return the selector lever to neutral and push the emergency knob down. Operate the handpump until the indicator shows that the wheels are locked down, or until considerable resistance is felt for several strokes. This, however, will not lower the tailwheel.

(b) Return the emergency knob to the UP position. Put the flap selector lever DOWN and handpump until the flaps are 15° down. Then return the selector lever to neutral.

(c) Select undercarriage DOWN, and use the handpump in an attempt to lower the tailwheel. Increased resistance to the handpump indicates when the operation is complete.

(d) Lower the flaps fully, or as required, using the handpump. Return the flaps selector lever to neutral.

(e) If the main wheels fail to lock down, or to remain locked down, push the emergency knob down again and maintain pressure on the undercarriage by using the handpump during the landing (see sub para, (i) (b)).

60. **Flapless landing**

The approach with flaps up is very flat, and difficulty may be experienced in maintaining a steady airspeed. At the maximum landing weight the final approach should be made at 115 knots. At light loads, this speed may be reduced by 5 knots. The touchdown is straightforward and the landing run, although lengthened, does not become excessive.

61. **Bombs, R.P. and wing drop tank jettisoning**

(i) *Bombs and wing drop tanks*

(a) Select bomb doors DOWN.

(b) Check doors open with warning light.

(c) Jettison small bomb containers by pressing the button (27).

(d) Select all bombs, and press the release button (45) on the control column ; this will release the fuselage bombs unfused, and the wing bombs or wing drop tanks.

A.L.I Para. 61 (ii)

(ii) *R.P.*

Rocket projectiles cannot be jettisoned except by firing as stated in para. 29 (ii).

62. **Fire-extinguishers**

The engine fire-extinguisher buttons (70) are on the electrical panel on the cockpit starboard wall. They

operate automatically in the event of a crash. A hand fire-extinguisher is provided to the right of the pilot's seat. Mod. 1145 introduces a fire warning light which is positioned in the centre of each feathering pushbutton. When this light glows red it indicates an outbreak of fire at the appropriate engine.
A semi-automatic fire-extinguisher system will be introduced under Mod. 1398.

63. **Parachute exit**

Exit should be made through the entrance door, which must first be jettisoned by pulling the handle (80) and kicking out. Do not touch the normal handle. If possible feather the starboard propeller before leaving the aircraft.

64. **Crash exit**

Through the roof panel—pull down the red lever in front of the panel and push out.

65. **Ditching**

(i) The aircraft may be successfully ditched but, whenever possible, it should be abandoned by parachute.

(ii) When ditching, jettison the roof panel but keep the entrance door closed.

(iii) Lower the flaps 15°

(iv) The harness should be tight and locked.

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

(vi) If power is available it should be used to reduce speed of touchdown as far as possible.

66. **Crash landing**

Cases have occurred of paddle-bladed propellers, when under power, breaking on impact, when the port propeller is liable to cause injury to the pilot's legs. The engines should, therefore, be throttled fully back before touching down.

67. **IFF**

The demolition switches (69) for the IFF are on the electrical panel aft of the master switch (68).

68. **Signal pistol**

A signal pistol is mounted in the centre of the cockpit roof above the pilot's head. A stowage for ten cartridges is provided under the observer's seat.

69. Emergency equipment

(i) *Desert equipment*

Desert equipment is stowed in the rear fuselage and is accessible through the rear hatch.

(ii) *Dinghy*

An L type dinghy with an emergency pack is stowed in the fuselage above the centre section. The dinghy is inflated automatically by an immersion switch, or manually by pulling the release cable in the roof behind the pilot's head.

(iii) *Crash axe*

This is stowed at the back of the pilot's seat.

(iv) *First-aid outfit*

This is stowed under the pilot's seat.

KEY TO *Fig.* I

COCKPIT—CENTRE

1. Coolant temperature gauges.
2. Compass.
3. Oil temperature gauges.
4. Oil pressure gauges.
5. Fuel pressure warning lights (see para. 5).
6. Boost pressure gauges.
7. Floodlights.
8. R.p.m. indicators.
9. Floodlight rheostats.
10. Stowage for R.I. compass repeater.
11. Exciter button for U.V. lighting.
12. Boost control cut-out (see para 20).
13. Instrument flying panel.
14. Gunsight bracket.
15. Radiator shutter switches.
16. Air-intake filter switch.
17. Ultra violet lamp.
18. Magneto switches.
19. Rudder trimming tab and indicator.
20. Electrical services switch.
21. Immersed pump warning light.
22. Engine starter switches.
23. Booster-coil switches.
24. Ventilators.
25. Feathering buttons.
26. Bomb doors warning light.
27. Bomb containers and wing drop tanks jettison button.
28. Bombs or tanks/camera change-over switch.
29. Flaps selector lever.
30. Bomb selector switches.
31. Bomb fusing switches.
32. Undercarriage selector.
33. Gun master switch.
34. Bomb doors selector.
35. Oxygen regulator.
36. Triple pressure gauge.
37. Flaps position indicator.
38. Undercarriage position indicator.
39. Landing lamp switches.

46. **Position error corrections**

The position error corrections are negligible and may be disregarded.

47. **Approach and landing**

(i) Carry out items 106 to 112 in the Pilot's Check List.

(ii) From 17,000 lb. to 18,000 lb. the following final approach speeds are recommended :—

	Flaps down
Engine assisted	100-105 knots

At full load this speed should be increased by about 5 knots.

(iii) With the undercarriage and flaps down the rate of descent is very high. If undershooting, corrective action entails the use of more power than might be expected.

(iv) After landing and when clear of the runway carry out items 113 to 117 in the Pilot's Check List.

48. Mislanding and going round again

The aircraft will climb satisfactorily at approximately 120 knots with flaps and undercarriage down at climbing power.

(i) Open the throttles to +9 lb./sq. in. boost.

(ii) Raise the undercarriage and while it is retracting raise the flaps to 15°, and re-trim.

(iii) At a safe height and speed retract the flaps fully and retrim.

49. Stopping the engines

(i) If the serviceability of the engine is in doubt, such items of the run-up given in para. 38 as may be necessary should be carried out. In all cases, however, the engines should be idled at 1.000 r.p.m. for a short period and during this period if no other check of the ignition has been made the magnetos should be tested for a dead cut.

(ii) To stop the engines the slow-running cut-outs should be pulled out until the engines have stopped, after which they should be released smartly.

(iii) After the engines have stopped, carry out items 118 to 128 in the Pilot's Check List.

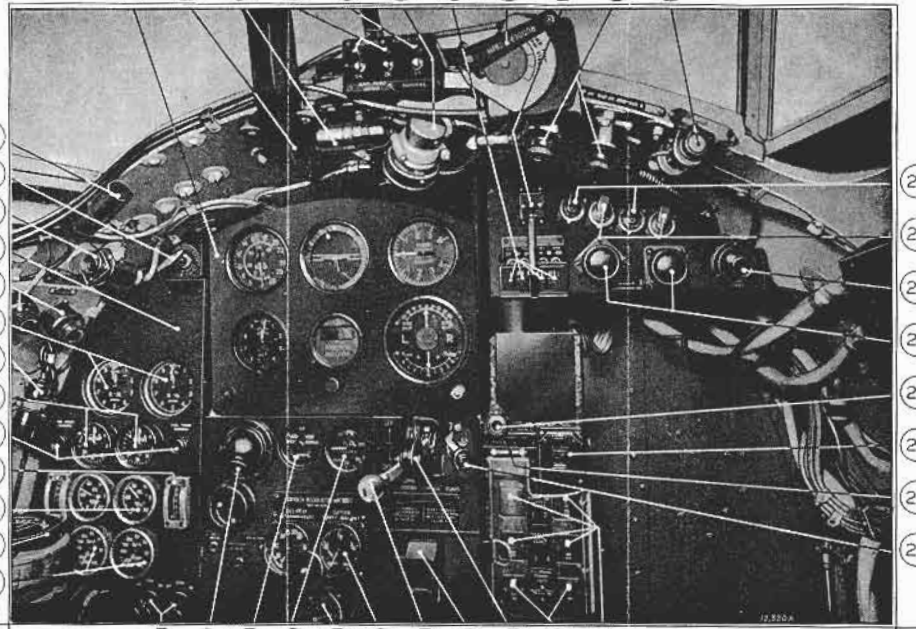

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FIG 1

FIG 1

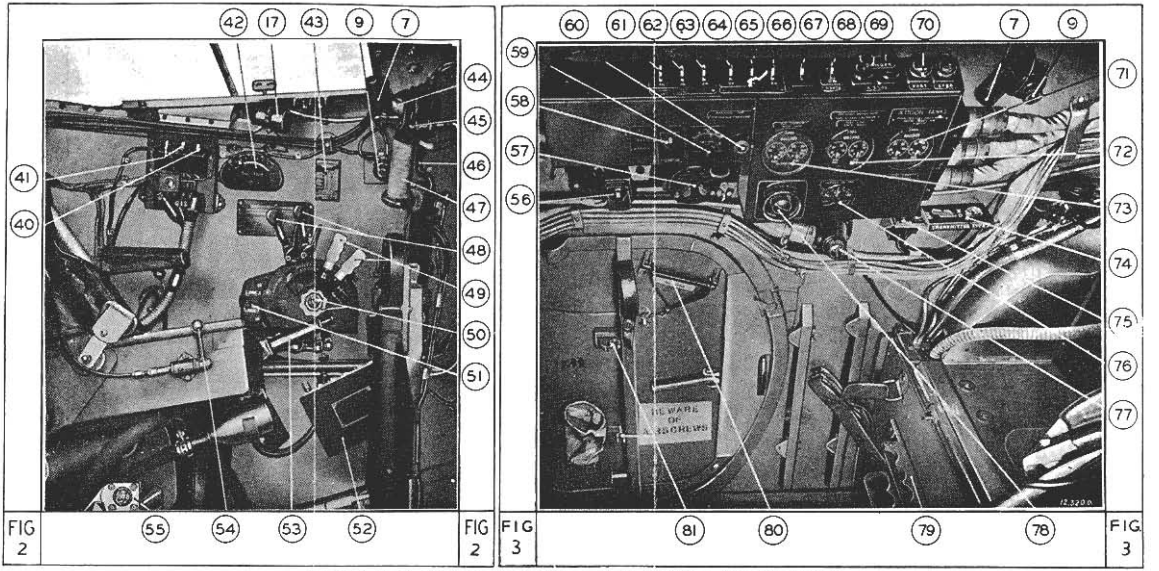

FIG 2

FIG 3

KEY TO *Fig.* 2—COCKPIT—PORT SIDE & *Fig.* 3—COCKPIT—STARBOARD SIDE.

40. Beam approach switch.
41. R.I. compass switches.
42. Elevator trimming tab indicator.
43. Engine limitations data plate.
44. Gun firing control.
45. Bomb release button.
46. Wheel brakes control lever.
47. Control column.
48. Throttle levers.
49. R.p.m. control levers.
50. Friction controls.
51. Supercharger gear change switch.
52. V.H.F. controller.
53. Seat height-adjusting lever.
54. Harness release lever.
55. Socket for hydraulic handpump.
56. Air recognition lights switch.
57. Identification lights switch box and key.
58. Identification lights colour selector switch.
59. Voltmeter.
60. Generator warning light.
61. Cine-camera master switch.
62. Navigation lights switch.
63. U.V. lights switch.
64. Pressure-head heater switch.
65. Immersed fuel pump switch.
66. Reflector gunsight switch.
67. Navigation head lamp switch.
68. IFF master switch.
69. IFF detonator pushbuttons.
70. Fire-extinguisher switches.
71. Fuel contents gauges—outer wing tanks.
72. Fuel contents gauges — centre tank, and long-range tank (if fitted).
73. Fuel contents gauges—inner wing tanks.
74. Switch and warning light for transmitter type F.
75. Master switches for R1155 and TR1143.
76. Outside air temperature gauge.
77. Ventilation control.
78. Windscreen wiper rheostat.
79. Stowage for signal cartridges.
80. Emergency door release handle.
81. Stowage for hydraulic handpump handle.