2nd EDITION

A.P. 1565J—P.N.

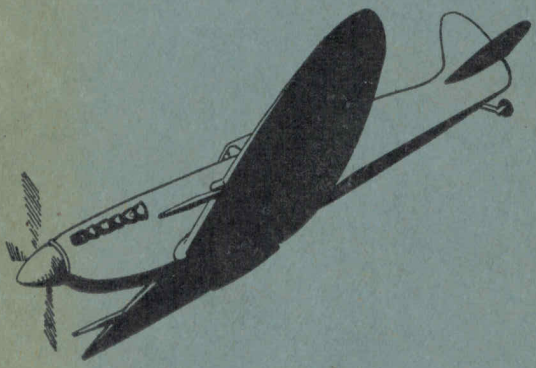
A.P. 1565OOP - P.N.

PILOT'S NOTES

FOR

SPITFIRE F.IX & P.R.XI

MERLIN 61, 63, 66 or 70 ENGINE



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AMENDMENTS

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

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A.L. No.	INITIALS	DATE	A.L. No.	INITIALS	DATE
1	A.L.	9.10.44	7		
2			8		
3			9		
4			10		
5			11		
6			12		

NOTES TO USERS

THIS publication is divided into five parts: Descriptive, Handling, Operating Data, Emergencies, and Illustrations. Part I gives a brief description of the controls with which the pilot should be acquainted.

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. A93/43).

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

Additional copies may be obtained from A.P.F.S., Fulham Road, S.W.3, by application on R.A.F. Form 294A, in duplicate, quoting the number of this publication in full—A.P. 1565J—P.N.

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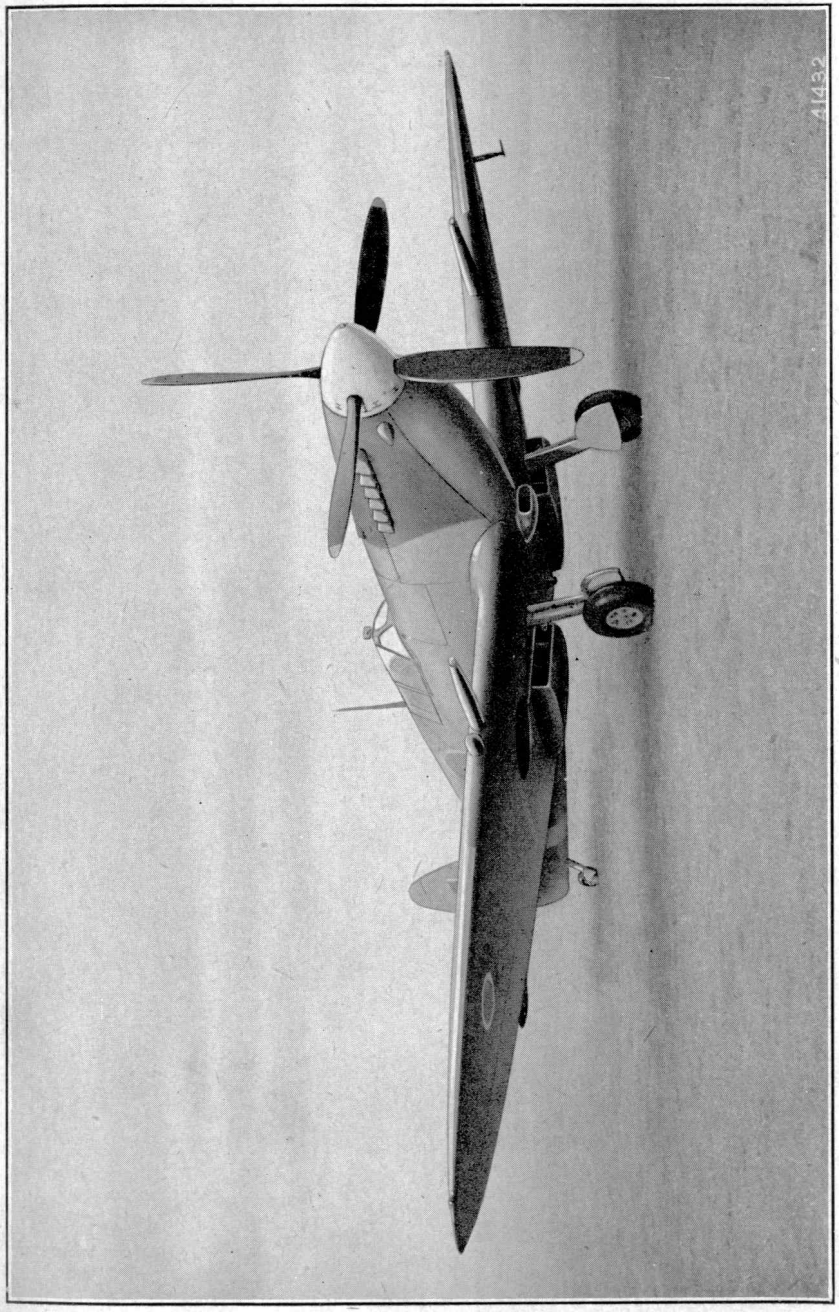


SPITFIRE F. IX

AIR MINISTRY
August 1943

AIR PUBLICATION 1565J—P.N.
Pilot's Notes

SPITFIRE F.IX PILOT'S NOTES

2nd Edition. This Edition supersedes all previous issues.

LIST OF CONTENTS

SPITFIRE P.R.XI

INTRODUCTION

1. The Spitfire P.R. Mk. XI is basically a Mark IX aircraft, fitted with a Merlin 61, 63 or 70 engine, and differs from it only in the fuel and oil systems and the special photographic equipment that is carried. This supplement describes the fuel system and its management.

FUEL SYSTEM

2. **Fuel tanks.**—In addition to the two main tanks, a tank of 66 gallons capacity is fitted in the leading edge of each wing, increasing the total fuel capacity to 217 gallons.

3. **Fuel cocks.**—The wing tank cocks are each controlled by a corresponding lever on the left-hand side of the cockpit.

4. **Contents gauges.**—A contents gauge is provided for each wing tank on the corresponding side of the instrument panel. There is also a gauge for the top main tank, next to the lower main tank gauge.

5. **Booster pumps.**—On later aircraft there is an electric booster pump in each wing tank and in the lower main tank, each operated by a separate switch on the right-hand side of the cockpit. These three switches are being replaced by a single selector switch which ensures that only one pump is switched on at a time.

OIL SYSTEM

6. **Oil tank.**—The oil tank has a capacity of 14·5 gallons. The system is otherwise similar.

MANAGEMENT OF FUEL SYSTEM

7. **The following drill is recommended**

(i) Start, warm up and take-off on the main tanks.

(ii) At a safe height change over to one of the wing tanks.

(iii) Fly on each wing tank alternately for twenty minutes until the fuel in both has been consumed. This will be indicated by the fuel pressure warning light. Change back to the main tanks.

(iv) The following procedure must be adopted at each change of tanks:
First switch OFF the booster pump of the tank in use and then turn ON the cock of the next tank in sequence. Then switch ON the appropriate booster pump and turn OFF the cock of the tank just used.

NOTE.—It is important, where separate switches are fitted, that not more than one booster pump should be running at a time, as the load on the generator is excessive and an electrical failure may occur. By operating the wing tank cocks every twenty minutes the possibility of freezing up at altitude is lessened.

PART I

DESCRIPTIVE

NOTE.—The numbers quoted in brackets after items in the text refer to key numbers of the illustrations in Part V.

INTRODUCTION

1. **The Spitfire** F. Mk. IX is fitted with a Merlin 61 or 63 engine, with two-speed two-stage supercharging. The Spitfire LF. Mk. IX is fitted with a Merlin 66 engine, which gives better performance at low altitudes. The Spitfire HF. Mk. IX has a Merlin 70 engine, giving improved performance at high altitudes. Merlin 61 and 63 engines have S.U. carburettors, and Merlin 66 and 70 engines have Bendix-Stromberg carburettors. All are fitted with Rotol 35° four-bladed propellers. The aircraft controls, including the undercarriage, flaps and brakes, are identical with those on earlier Marks.

FUEL, OIL AND COOLANT SYSTEMS

2. **Fuel tanks** (*see* Fig. 4).—Fuel is carried in two tanks mounted one above the other (the lower one is self-sealing) forward of the cockpit. The top tank feeds into the bottom tank and fuel is delivered to the carburettor, through a filter, by an engine-driven pump. On Merlin 61 and 63 engine installations there is a fuel cooler and on Bendix-Stromberg carburettor installations, a de-aerator in the carburettor, for separating accumulated air from the fuel, is vented to the top tank.

The main tank capacities are as follows:

Top tank	48 gallons
Bottom tank	37 gallons
	85 gallons

An auxiliary drop tank of 30, 90 or 170 gallons capacity can be fitted under the fuselage and on some aircraft a second auxiliary tank of 26 gallons capacity is fitted in the rear fuselage for use with the 170-gallon tank on

reinforcing flights. To meet the possibility of engine cutting due to fuel boiling in warm weather at high altitudes, the main tanks can be pressurised (operative above 20,000 feet). Pressurising, however, impairs the self-sealing of tanks and should, therefore, be used only when the fuel pressure warning light comes on.

3. **Fuel cocks.**—The cock control for the main tanks is a lever (47) fitted below the engine starting push-buttons and the pressurising control (50) is below the right-hand side of the instrument panel. The cock control (58) and jettison lever (59) for the auxiliary drop tank are mounted together on the right-hand side of the cockpit, below the undercarriage control unit. The jettison lever is pulled up to jettison the drop tank, but cannot be operated until the cock control is moved forward to the OFF position. The cock for the rear fuselage tank (when fitted) is to the left of the seat.

4. **Fuel pumps.**—On Stromberg carburettor installations an electric booster pump, operated by a switch on the left-hand side of the cockpit, is fitted in the lower main tank for facilitating engine starting and engine recovery during combat, and should, therefore, be left on in flight. On early aircraft this pump is not fitted, but a hand wobble pump is provided instead, just forward of the remote contactor.

5. **Fuel contents gauge and pressure warning light.**—The contents gauge (19) on the instrument panel indicates the contents of the lower main tank when the adjacent pushbutton is pushed. The fuel pressure warning light (18), operated by the small switch (34) on the throttle quadrant, comes on when the pressure drops to 6 lb./sq.in. (10 lb./sq.in. on Stromberg carburettor installations).

6. **Oil system.**—Oil is supplied by a tank of 7·5 gallons oil capacity under the engine mounting, which is pressurised to 2½ lb./sq.in., and passes through a filter before entering the engine. An oil cooler is fitted in the under-side of the port wing and oil pressure (20) and temperature (17) gauges are fitted on the instrument panel. When carrying an auxiliary fuel tank of 170 gallons capacity a larger oil tank of either 8·5 or 14·5 gallons capacity must be fitted.

7. **Engine coolant system.**—The system is thermostatically controlled, the under-wing radiators being by-passed until the coolant reaches a certain temperature. The header tank is mounted above the reduction gear casing and is fitted with a relief valve. The radiator flaps are fully automatic and are designed to open at a coolant temperature of 115° C. A pushbutton is fitted on the electrical panel for ground testing and there is a coolant temperature gauge (16) on the instrument panel.

8. **Intercooler system.**—The high temperatures resulting from two-stage supercharging necessitate the introduction of an intercooler between the supercharger delivery and the induction manifolds, particularly when S ratio is used. An auxiliary pump passes the coolant from a separate header tank to a radiator under the starboard wing, and thence through the supercharger casing to the intercooler, where the charge is cooled by loss of heat passing to the coolant. On early aircraft a thermostatically operated switch in the induction pipe is connected to the supercharger operating ram and causes it to change the supercharger to M ratio in the event of the charge temperature becoming excessive. This change of gear ratio is indicated to the pilot by a pushbutton, which springs out on the instrument panel. The supercharger will change back to S gear after the temperature of the charge has returned to normal and the pushbutton has been pushed in. If, however, the excessive temperature is of a permanent nature, due to failure of the intercooler system, the pushbutton will continue to spring out and the flight should be continued in M gear.

MAIN SERVICES

9. **Hydraulic system.**—Oil is carried in a reservoir on the fireproof bulkhead and passes through a filter to an engine-driven pump for operation of the undercarriage.

10. **Electrical system.**—A 12-volt generator supplies an accumulator which in turn supplies the whole of the electrical installation. A voltmeter (10) across the accumulator is fitted at the top of the instrument panel

and a red light (40), on the electrical panel, marked Power Failure, is illuminated when the generator is not delivering current to the accumulator.

NOTE.—If the electrical system fails or is damaged, the supercharger will be fixed in M ratio and the radiator flaps will remain closed.

11. **Pneumatic system.**—An engine-driven air compressor feeds two storage cylinders for operation of the flaps, radiator flaps, supercharger ram, brakes and guns. The cylinders each hold air at 300 lb./sq.in. pressure.

NOTE.—If the pneumatic system fails, the supercharger will be fixed in M ratio, but the position of the radiator flaps will depend on the nature of the failure.

AIRCRAFT CONTROLS

12. **Trimming tabs.**—The elevator trimming tabs are controlled by a handwheel (30) on the left-hand side of the cockpit, the indicator (24) being on the instrument panel. The rudder trimming tab is controlled by a small handwheel (27) and is not provided with an indicator. The aircraft tends to turn to starboard when the handwheel is rotated clockwise.

13. **Undercarriage control.**—The undercarriage selector lever (52) moves in a gated quadrant on the right-hand side of the cockpit. An automatic cut-out in the control moves the selector lever into the gate when it has been pushed or pulled to the full extent of the quadrant and when the operation of the undercarriage is complete. A hydraulic valve indicator in the quadrant shows DOWN, or IDLE or UP, depending upon the position of the hydraulic valve. UP or DOWN should normally show only when the selector lever is operated to raise or lower the undercarriage and IDLE when the lever has automatically sprung back into the gate after raising or lowering the undercarriage. If, with the engine not running, the indicator shows DOWN, it should return to IDLE when the engine is started.

To raise the undercarriage the lever is pushed forward, but it must first be pulled back and then across to disengage it from the gate. When the undercarriage is raised and locked, the lever will spring into the forward gate.

To lower the undercarriage the lever is pulled back, but it must first be pushed forward and then across to disengage it from the gate. When the undercarriage is lowered and locked the lever will spring into the rear gate.

14. **Undercarriage indicators:**

(*a*) *Electrical visual indicator.*—The electrically operated visual indicator (2) has two semi-transparent windows on which the words UP on a red background and DOWN on a green background are lettered; the words are illuminated according to the position of the undercarriage. The switch (34) for the DOWN circuit is moved to the on position by a striker on the throttle lever as the throttle is opened.

(*b*) *Mechanical position indicators.*—A rod that extends through the top surface of the main plane is fitted to each undercarriage unit. When the wheels are down the rods protrude through the top of the main planes and when they are up, the top of the rods, which are painted red, are flush with the main plane surfaces.

15. **Undercarriage warning horn.**—The horn sounds when the throttle lever is nearly closed and the undercarriage is not lowered, and cannot be silenced until the throttle is opened again or the undercarriage is lowered.

16. **Flap control.**—The split flaps have two positions only, up and fully down. They are controlled by a finger lever (5) on the instrument panel.

17. **Wheel brakes.**—The brake lever is fitted on the control column spade grip and a catch for retaining it in the on position for parking is fitted below the lever pivot. A triple pressure gauge (25), showing the air pressures in the pneumatic system cylinders and at each brake, is mounted on the instrument panel.

18. **Flying control locking struts.**—Two struts are stowed on the right-hand side of the cockpit aft of the seat. The longer strut and the arm attached to it lock the control

column to the seat and to the starboard datum longeron, and the shorter strut, attached to the other strut by a cable, locks the rudder pedals. The controls should be locked with the seat in its highest position.

ENGINE CONTROLS

19. **Throttle.**—The throttle lever (33) is gated at the take-off position. There is a friction adjuster (31) on the side of the quadrant. The mixture control is automatic and there is no pilot's control lever.

20. **Propeller control.**—The speed control lever (35) on the throttle quadrant varies the governed r.p.m. from 3,000 down to 1,800. The friction adjuster (46) is on the side of the quadrant.

21. **Supercharger controls.**—The two-speed two-stage supercharger automatically changes to S ratio at about 21,000 feet (14,000 feet on Merlin 66 installations) on the climb, and back to M ratio at about 19,000 feet (12,500 feet on Merlin 66 installations) on the descent. An over-ride switch is fitted on the instrument panel by means of which M ratio may be selected at any height. There is a pushbutton (42) on the electrical panel for testing the gear change on the ground, and a red light (13) on the instrument panel comes on when S ratio is engaged, on the ground or in flight.

22. **Intercooler protector.**—The pushbutton (15) on the instrument panel, on early aircraft, springs out when the charge temperature becomes excessive and the supercharger automatically changes to M ratio. It may be re-set by being pushed in and will remain in and allow the supercharger to return to S ratio when the temperature of the charge returns to normal.

23. **Radiator flap control.**—The pushbutton (41) for testing the radiator flaps is on the electrical panel.

24. **Slow-running cut-out (Merlin 61 and 63 installations only).**—The control on the carburettor is operated by pulling the ring (37) below the left-hand side of the instrument panel.

25. **Idle cut-off control (Merlin 66 and 70 installations only).**—The idle cut-off valve on Stromberg carburettors is operated by moving the short lever on the throttle quadrant through the gate to the fully aft position. On early Stromberg carburettor installations this lever is not fitted, but the cut-off valve is operated by the ring (37) which on other aircraft operates the slow-running cut-out.

26. **Cylinder priming pump.**—A hand-operated pump (48) for priming the engine is fitted below the right-hand side of the instrument panel.

27. **Ignition switches and starter buttons.**—The ignition switches (1) are on the left-hand side of the instrument panel and the booster-coil (22) and the engine starter (21) pushbuttons immediately below it. Each bushbutton is covered by a safety shield.

28. **Ground battery starting.**—The socket for starting from an external supply is mounted on the starboard engine bearer.

OTHER CONTROLS

29. **Cockpit door.**—The cockpit door is provided with a two-position catch which allows it to be partly opened and so prevent the hood from sliding shut when taking-off and landing, and in the event of a forced landing. It will be found that the catch operates more easily when the aircraft is airborne than when on the ground.

30. **Signal discharger.**—The recognition device fires one of six cartridges out of the top of the rear fuselage when the handle (39) to the left of the pilot's seat is pulled upwards. On some aircraft a pre-selector control (38) is mounted above the operating handle.

PART II

for P.R. XI A/c Sal

HANDLING

Page 4 B.

31. **Management of fuel system.**—with auxiliary tanks.

(i) *Flying restrictions:*

(*a*) When fitted with a 90-gallon drop tank the aircraft is restricted to "straight flying" (*see* A.P. 2095, I.A.3) until the tank is jettisoned.

NOTE.—This restriction does not apply when fitted with a 30-gallon drop tank.

(*b*) On re-inforcing flights, when fitted (*a*) with a 170-gallon drop tank or (*b*) with a 170-gallon drop tank and a 26-gallon rear fuselage tank, the aircraft is restricted to straight flying until the 170-gallon tank is jettisoned and the 26-gallon tank is empty.

(*c*) Drop tanks should be jettisoned only in straight and level flight, and then only if absolutely necessary.

(ii) *Management of tanks:*

(*d*) Start, warm up and take off on the main tanks and change over to the drop tank at a safe height (say 2,000 feet). Turn OFF the main tanks.

(*e*) When the engine cuts, turn OFF the drop tank, turn ON the rear fuselage tank (if fitted) or main tanks, and if maximum range is required, or in other special circumstances, jettison the tank.

(*f*) At no time should the drop tank cock and the rear fuselage tank cock be ON together, or fuel in the rear fuselage tank will be lost, as the rear fuselage tank connection joins the drop tank connection below the non-return valve. This applies whether or not the tank has been jettisoned.

(*g*) If a tank has to be jettisoned before it is empty, first turn ON the main tanks and then turn OFF the drop tank. Then change over to the rear fuselage tank (if fitted) when convenient.

NOTE.—It is necessary to ensure that the drop tank cock is in the fully OFF position when the tank is empty or jettisoned; otherwise, air may be sucked into the main fuel system and, if a rear fuselage tank is fitted, fuel will be lost from it.

32. **Preliminaries**

(i) Check contents of fuel tanks. If fitted with auxiliary tank(s) check that corresponding cock(s) are OFF.

(ii) Check that the undercarriage selector lever is down; switch on indicator and see that DOWN shows green.

(iii) Test operation of flying controls.

(iv) In order to avoid damage to the propeller the ground immediately below it should be cleared of any small stones or rubble before starting the engine.

33. **Starting the engine and warming up**—F. Mk. IX.

(Merlin 61 and 63 engines)

(i) Set fuel cock ON.

(ii) Set the controls as follows:

Throttle	½ inch open
Propeller control	Fully forward

(iii) If an external priming connection is fitted, high volatility fuel (Stores ref. 34A/111) should be used for priming at temperatures below freezing. Work the Ki-gass priming pump until the fuel reaches the priming nozzles; this may be judged by a sudden increase in resistance.

(iv) Switch ON the ignition and press the starter and booster-coil buttons. Turning periods must not exceed 20 seconds, with a 30 seconds wait between each. Work the priming pump as rapidly and vigorously as possible while the engine is being turned; it should start after the following number of strokes if cold:

Air temperature °C.	+30	+20	+10	0	−10	−20
Normal fuel ..	3	4	7	12		
High volatility fuel				4	8	18

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

(vi) Release the starter button as soon as the engine starts, and as soon as the engine is running satisfactorily release the booster-coil button and screw down the priming pump.

(vii) Open up slowly to 1,000 r.p.m., then warm up at this speed.

34. **Starting the engine and warming up**—LF. and HF. Mk. IX. (Merlin 66 and 70 engines)

(i) Set fuel cock ON.

(ii) Set the controls as follows:

Throttle	½ inch open
Propeller control	Fully forward

(iii) If an external priming extension is fitted, high volatility fuel (Stores ref. 34A/111) should be used for priming at temperatures below freezing. Work the Ki-gass priming pump until the fuel reaches the priming nozzles (this may be judged by a sudden increase in resistance) and then give the following number of strokes if cold:

Air temperature °C.	+30	+20	+10	0	−10	−20
Normal fuel ..	3	4	7	12		
High volatility ..				4	8	18

(iv) Move the idle cut-off control to the fully aft (closed) position and switch on the booster pump (or operate the wobble pump until the pressure warning light goes out).

NOTE.—When the idle cut-off valve is operated by pulling the ring, the latter must be held out until the engine starts. Neither the booster pump nor the wobble pump must be operated unless the cut-off valve is closed or the engine is running. The wobble pump may be operated again, if necessary, after the engine has started and the idle cut-off control has been moved forward (or the ring released).

(v) Switch ON the ignition and press the starter and booster-coil pushbuttons.

(vi) As soon as the engine fires, release the starter button and move the idle cut-off control forward (or release the ring if used). Release the booster-coil button and screw down the priming pump as soon as the engine is running satisfactorily.

NOTE.—If the engine is over-primed and fails to start, operate the idle cut-off control and switch off the booster pump or stop working the wobble pump while the engine is cleared by turning it through two or three revolutions.

(vii) Open up slowly to 1,000 r.p.m., then warm up at this speed.

35. **Testing engine and installations**

While warming up:

(i) Check temperatures and pressures.

(ii) Press the radiator test pushbutton and have ground crew check that shutters open.

After warming up, with three men on the tail and one on the starboard wing-tip:

(iii) Open up to +4 lb./sq.in. boost; exercise and check operation of the two-speed supercharger by operating the test pushbutton. R.p.m. should fall when S ratio is engaged and the red light should come on.

(iv) At +4 lb./sq.in. boost exercise and check operation of the constant-speed propeller. R.p.m. should fall to 1,800 with the control fully back.

(v) With the propeller control fully forward, open the throttle to the gate and check take-off boost and static r.p.m., which should be 3,000 at take-off boost.

(vi) Throttle back to +9 lb./sq.in. boost and test each magneto in turn. The drop should not exceed 150 r.p.m.

(vii) Before taxying, check brake pressure (80 lb./sq.in.) and pneumatic supply pressure (220 lb./sq.in.).

36. **Check list before take-off**

T—Trimming tabs	Elevator: Half a division nose down Rudder: Fully right
P—Propeller control	Fully forward
F—Fuel	Check contents of lower main tank Drop tank cock—OFF Pressurising cock—OFF Electric booster pump (if fitted)—ON Rear fuselage tank cock (if fitted)—OFF
F—Flaps	UP
Supercharger ..	Over-ride switch AUTO. Red light out

37. **Take-off**

(i) Open the throttle slowly, to the gate if +12lb./sq.in. boost is needed, +7 lb./sq.in. is sufficient for normal take-off.

(ii) Any tendency to swing can be counteracted by the rudder.

(iii) After raising the undercarriage, see that the red indicator light—UP—comes on. It may be necessary to hold the lever hard forward against the quadrant until it does come on. Failure of the wheels to lock up may spoil the air flow through the radiator and air cooler and result in excessive temperatures.

(iv) Do not start to climb before a speed of 140 m.p.h. I.A.S. is attained.

38. **Climbing**

(i) The speed for maximum rate of climb is 160 m.p.h. I.A.S. from sea level up to 26,000 feet.
The reduction gear ratio on some early Merlin 61 engines is ·42:1 and the maximum rate of climb for these is 180 m.p.h. I.A.S. from sea level up to 15,000 feet.

(ii) The fuel tank pressure cock should normally be kept OFF, but should be turned ON if the fuel pressure warning light comes on. [This indicates that pressure has dropped to 5–6 lb./sq.in. (10 lb./sq.in. on Stromberg carburettor installations).]

39. **General flying**

(i) *Stability.*—There is more longitudinal stability than on earlier Marks.

(ii) *Change of trim:*

Undercarriage down:	Nose down
Flaps down:	Nose down

(iii) In bad visibility near the ground, flaps should be lowered and the propeller set to give 2,650 r.p.m. Speed may then be reduced to 130 m.p.h. I.A.S.

40. **Stalling**

The stalling speeds (engine off) in m.p.h. I.A.S. at normal A.U.W. (7,445 lbs.) are as follows:

Undercarriage and flaps up:	86
Undercarriage and flaps down:	76

41. **Spinning**

(i) Spinning is permitted, but the loss of height involved in recovery may be very great and the following limits are to be observed:

(*a*) Spins are not to be started below 10,000 feet.

(*b*) Recovery must be initiated before two turns are completed.

[illegible] be attained before

A.L.1 PART II Para. 41 (iii)

(iii) spinning is not permitted when fitted with a drop tank or when carrying a bomb.

42. **Diving**

(i) The aircraft becomes increasingly tail-heavy and some nose down trim should be used to reduce the push required.

(ii) A tendency to yaw to starboard should be corrected by use of the rudder trimming tab.

(iii) When carrying a bomb, the angle of dive must not exceed 40°.

43. **Aerobatics**

(i) The following speeds (m.p.h. I.A.S.) are recommended:

Loop	280–300
Roll	220–260
Half-roll off loop	320–350
Upward roll	330–380

(ii) Flick manœuvres are not permitted.

44. **Check list before landing**

(i) Reduce speed to 160 m.p.h. I.A.S. and open the cockpit hood.

U —Undercarriage	DOWN
P —Propeller control	Fully forward.
Supercharger	Red light out.
F —Flaps	DOWN.

(ii) Check brake pressure (80 lb./sq.in.) and pneumatic supply pressure (220 lb./sq.in.).

45. **Approach and landing**

(i) *Approach speeds at full load in m.p.h. I.A.S.:*

		(flaps up)
Engine assisted:	95	(105)
Glide:	105	(110)

NOTE.—In all cases speed may be reduced by 5 m.p.h. when cannon ammunition or considerable fuel has been expended.

(ii) When lowering the undercarriage hold the lever fully forward for about two seconds. This will take the weight off the locking pins and allow them to turn freely when the lever is pulled back. The lever should then be pulled back smartly to the down position and left there.
It should NOT be pushed into the gate by hand. As soon as the undercarriage is locked down the lever should automatically spring into the gate and the hydraulic valve indicator return to IDLE. If it cannot be pulled fully back, hold it forward again for at least two seconds. If it becomes jammed it may generally be

released by a smart blow of the hand. If this fails it is necessary to take the weight of the wheels off the locking pins, either by pushing the nose down sharply or by inverting the aircraft. The lever can then be pulled straight back.

(iii) If the green indicator light does not come on, hold the lever fully back for a second. If this fails, raise the undercarriage and repeat the lowering. If this fails also, use the *emergency system* (see Part IV).

NOTE.—Before the emergency system can be used the control lever must be in the down position. It may be necessary to push the nose down or invert the aircraft in order to get the lever down.

(iv) If the undercarriage is lowered too late on the approach, with insufficient engine speed to develop full hydraulic pressure, the selector lever may not automatically spring from the fully back position into the gate, so indicating that the operation is not complete. This may cause the undercarriage to collapse on landing. (As previously mentioned the lever must NOT be pushed into the gate by hand). It is advisable, therefore, to lower the undercarriage early on the circuit prior to landing and not in the later stages of the approach.

(v) The aircraft is nose-heavy on the ground; the brakes, therefore, must be used carefully on landing.

46. **Mislanding**

(i) Raise the undercarriage.

(ii) Climb at about 130 m.p.h. I.A.S. with flaps fully down.

(iii) Raise flaps at a safe height of about 200-300 feet.

(iv) Retrim.

47. **After landing**

(i) Raise the flaps before taxying.

(ii) To stop the engine, idle for ½ minute at 800–900 r.p.m., then pull the slow-running cut-out and hold it out until the engine stops. On Stromberg carburettor installations the idle cut-off control must be moved fully aft or pulled out and held out until the engine stops.

(iii) Turn OFF the fuel cock and switch OFF the ignition.

(iv) *Oil dilution*—(See A.P.2095).
The correct dilution period for this aircraft is:

Atmospheric temperature above −10°C.: 1 minute
Atmospheric temperature below −10°C.: 2 minutes

48. **Beam approach**

(i) The recommended speeds (m.p.h. I.A.S.), r.p.m. and flap settings are:

	Maintaining height		
	Preliminary manœuvring.	Manœuvring with u/c down	Final approach.
Speed	180	160	120
Flaps	UP	UP	DOWN
R.p.m.	2,650	2,650	Fully Forward

(ii) For change of trim see Para. 39 (ii).

(iii) Approach at 900 feet over the outer marker beacon, reducing to 200 feet over the inner marker beacon.

PART III

OPERATING DATA

49. **Engine data: Merlins 61, 63, 66 and 70**

(i) *Fuel.*—100 octane only.

(ii) *Oil.*—See A.P. 1464/C.37.

(iii) *Engine limitations:*

		R.p.m.	Boost lb./sq.in.	Temp.°C. Coolant	Temp.°C. Oil
MAX. TAKE-OFF TO 1,000 FEET	M	3,000	+12	135	—
MAX. CLIMBING ONE HOUR LIMIT	M S	2,850	+12	125	90
*MAXIMUM CONTINUOUS	M S	2,650	+ 7	105†	90
COMBAT 5 MINS. LIMIT	M S	3,000	+15‡	135	105

* For economical cruising see para. 53 (ii).
‡ +18 lb./sq.in. on Merlins 63, 66 and 70.
† 115°C. is permitted for short periods.

OIL PRESSURE:
NORMAL .. .. 60–80 lb./sq.in.
MINIMUM .. .. 45 lb./sq.in.

MINM. TEMP. FOR TAKE-OFF:
OIL .. .. 15°C.
COOLANT .. .. 60°C.

UEL PRESSURES:
Merlins 61 & 63 .. .. 8–10 lb./sq.in.
Merlins 66 & 70 .. .. 14-16 lb./sq.in.

50. **Flying limitations**

(i) *Maximum speeds*:
Diving: .. .. 450 m.p.h. I.A.S.
Undercarriage down: .. .. 160 m.p.h. I.A.S.
Flaps down: .. .. .. 160 m.p.h. I.A.S.

(ii) *Restrictions*:

(*a*) When carrying a bomb, spinning is not permitted and violent manœuvres must be avoided. The angle of dive must at no time exceed 40°.

(*b*) For restrictions when carrying a drop tank see Para. 31.

51. **Position error corrections**

From	120	150	170	210	240	290	m.p.h. I.A.S.
To	150	170	210	240	290	350	m.p.h. I.A.S.
Add	4	2	0				m.p.h.
Subtract			0	2	4	6	m.p.h.

52. **Maximum performance**

Climbing:

(i) The speeds for maximum rate of climb are as follows:

S.L. to 26,000 feet:	160 m.p.h. I.A.S.
26,000 to 30,000 feet:	150 m.p.h. I.A.S.
30,000 to 33,000 feet:	140 m.p.h. I.A.S.
33,000 to 37,000 feet:	130 m.p.h. I.A.S.
37,000 to 40,000 feet:	120 m.p.h. I.A.S.
Above 40,000 feet:	110 m.p.h. I.A.S.

(ii) On early Merlin 61 engines with a propeller reduction gear ratio of ·42:1 the speeds for maximum rate of climb are as follows:

S.L. to 15,000 feet:	180 m.p.h. I.A.S.
15,000 to 20,000 feet:	170 m.p.h. I.A.S.
20,000 to 30,000 feet:	160 m.p.h. I.A.S.
30,000 to 37,000 feet:	150 m.p.h. I.A.S.
Above 37,000 feet:	140 m.p.h. I.A.S.

53. **Economical flying**

(i) *Climbing.*—For maximum fuel economy climb at +7 lb./sq.in. boost and 2,650 r.p.m. at the speeds for maximum rate of climb. The climb to heights up to 30,000 feet may, however, be made at +12 lb./sq.in. and 2,850 r.p.m. without seriously increasing the total fuel consumption over that obtained on a climb at +7 lb./sq.in. boost and 2,650 r.p.m.

(ii) *Cruising.*—Greatest range will be obtained at medium heights. The recommended speeds are as follows:

(*a*) *Without auxiliary tanks, or if carrying a 30-gallon drop tank:*

170 m.p.h. I.A.S. At low altitudes speed should be increased to 180 m.p.h. I.A.S.

(*b*) *If carrying a 90-gallon drop tank:*

175 m.p.h. I.A.S. At low altitudes 180 m.p.h. I.A.S.

(*c*) *If carrying a 170-gallon drop tank:*

(i) *With 170-gallon tank on:*

185 m.p.h. I.A.S. at start of level flight reducing as fuel is consumed, to 170 m.p.h. I.A.S. when the drop tank is empty. By reducing r.p.m. by 50 at the end of each hour, the I.A.S. will be reduced by approximately the correct amount.

(ii) *After jettisoning tank and while using fuel in rear fuselage tank:*

170 m.p.h. I.A.S. when the rear fuselage tank is full, reducing as fuel is consumed, to 160 m.p.h. I.A.S. when the rear fuselage tank is empty.

NOTE.—At low altitudes the recommended speed is 180 m.p.h. I.A.S. after jettisoning the tank.

Fly at maximum obtainable boost not exceeding +4 lb./sq.in. and reduce speed by reducing r.p.m. which may be as low as 1,800 if this will give the recommended speed, but check that the generator is charging. If at 1,800 r.p.m. the speed is higher than that recommended, reduce boost.

54. **Fuel capacities and consumption**

(i) *Normal fuel capacity:*

Top tank	48 gallons
Bottom tank	37 gallons
Total	85 gallons

(ii) *Long-range fuel capacities:*

With 30-gallon drop tank:	115 gallons
With 90-gallon drop tank:	175 gallons
With 170-gallon drop tank:	255 gallons
With 170-gallon drop tank and 26-gallon rear fuselage tank:	281 gallons

(iii) *Fuel consumptions:*

The approximate fuel consumptions (gals./hr.) for the Merlin 61 and 63 engines are as follows:

Weak mixture (as obtained at +7 lb./sq.in. boost and below):

Boost lb./sq.in.	R.p.m.				
	2,650	2,400	2,200	2,000	1,800
+7	80	—	—	—	—
+4	71	66	61	54	—
+2	66	61	57	50	43
0	60	55	51	45	39
−2	53	49	45	40	35
−4	45	42	38	34	30

Rich mixture (as obtained above +7 lb./sq.in. boost):

Boost lb./sq.in.	R.p.m.	gals./hr.
+15	3,000	130
+12	2,850	105

NOTE.—Consumption figures for the Merlins 66 and 70 are not at present available, but will be inserted at a later date.

PART IV

EMERGENCIES

55. **Undercarriage emergency operation**

In the event of failure of the hydraulic system ensure that the undercarriage selector lever is in the DOWN position (this is essential) and push the emergency lowering lever forward and downward. The angular travel of the emergency lever is about 100° for puncturing the seal of the cylinder and then releasing the piercing plunger; it must be pushed through this movement and allowed to swing downwards. *No attempt should be made to return it to its original position until the cylinder is being replaced.*

56. **Hood jettisoning**

The hood may be jettisoned in an emergency by pulling the rubber knob inside the top of the hood in a forward and downward movement, and pushing the lower edge of the hood outboard with the elbows. A crowbar (26) for use in an emergency is stowed on the inside of the door.

57. **First-aid outfit**

The first-aid outfit is stowed aft of the wireless equipment and is accessible through a hinged panel on the port side of the fuselage.

58. **Forced landing**

In the event of having to make a forced landing the glide may be lengthened considerably by moving the propeller speed control fully back and gliding at about 130 m.p.h. The cockpit hood should be opened and the door put on the catch.

59. **Ditching** (See A.P.2095, Pilot's Notes General).

(i) In general, the pilot should if possible abandon the aircraft by parachute.

(ii) In the event of having to ditch, the auxiliary drop tank (if fitted) should be jettisoned, but only in straight and level flight, and the following procedure should be observed:

(*a*) The cockpit hood should be jettisoned.

(*b*) Flaps should be lowered in order to reduce landing speed as much as possible.

(*c*) The undercarriage should be retracted.

(*d*) The engine, if available, should be used to help make the touch-down in a tail-down attitude at as low a speed as possible.

(*e*) Ditching should be along the wave crests or wave tops.

(*f*) Safety harness should be kept on, with straps or other adjustments tight, in order to avoid injury to the pilot when the aircraft alights on the water.

60. **Failure of pneumatic system**

(*a*) If the flaps fail to lower when the control is moved to the DOWN position, it is probably due to a leak in the pipe line, resulting in complete loss of air pressure and consequent brake failure.

(*b*) Alternatively, if a leak develops in the flap control diaphragm the flaps will lower, but complete loss of air pressure will follow and the brakes will become inoperative.
(In this case a hissing sound may be heard in the cockpit after selecting flaps DOWN.)

(*c*) In either case the flap control should immediately be returned to the UP position in order to allow sufficient pressure to build up, so that a landing can be made with the brakes working but without flaps.

NOTE.—As a safeguard, pilots should always check the pneumatic pressure supply after selecting flaps DOWN.

PART V—*ILLUSTRATIONS*

KEY to Figs. 1, 2 and 3

1. Ignition switches.
2. Undercarriage indicator.
3. Oxygen regulator.
4. Navigation lamps switch.
5. Flap control.
6. Instrument flying panel.
7. Lifting ring for sunscreen.
8. Reflector sight switch.
9. Reflector sight base.
10. Voltmeter.
11. Cockpit ventilator control.
12. Engine-speed indicator.
13. Supercharger warning lamp.
14. Boost gauge.
15. Intercooler protector pushbutton.
16. Radiator temperature gauge.
17. Oil temperature gauge.
18. Fuel pressure warning lamp.
19. Fuel contents gauge and pushbutton.
20. Oil pressure gauge.
21. Engine starter pushbutton.
22. Booster-coil pushbutton.
23. Cockpit floodlight switches.
24. Elevator tab position indicator.
25. Brake triple pressure gauge.
26. Crowbar.
27. Rudder trimming tab handwheel.
28. Pressure-head heater switch.
29. Two-position door catch lever.
30. Elevator trimming tab handwheel.
31. Throttle lever friction adjuster.
32. Floodlight.
33. Throttle lever.
34. Undercarriage indicator master switch.
35. Propeller speed control.
36. T.R.1133 pushbutton control.
37. Slow-running cut-out.
38. Signal discharger pre-selector control.
39. Signal discharger firing control.
40. Power failure lamp.
41. Radiator ground test pushbutton.
42. Supercharger ground test pushbutton.
43. Oil dilution pushbutton.
44. Map case.
45. Rudder pedal adjusting starwheel.
46. Propeller control friction adjuster.
47. Fuel cock control.
48. Engine priming pump.
49. Signalling switchbox.
50. Fuel tank pressure cock.
51. Remote contactor and contactor switch.
52. Undercarriage control lever.
53. IFF pushbuttons.
54. Harness release control.
55. IFF master switch.
56. Undercarriage emergency lowering control.
57. Rudder pedal adjusting starwheel.
58. Jettisonable fuel tank cock control.
59. Jettisonable fuel tank jettison lever.
60. Windscreen de-icing cock.
61. Seat adjustment lever.
62. Windscreen de-icing needle valve.
63. Windscreen de-icing pump.
64. Microphone/telephone socket
65. Oxygen supply cock.

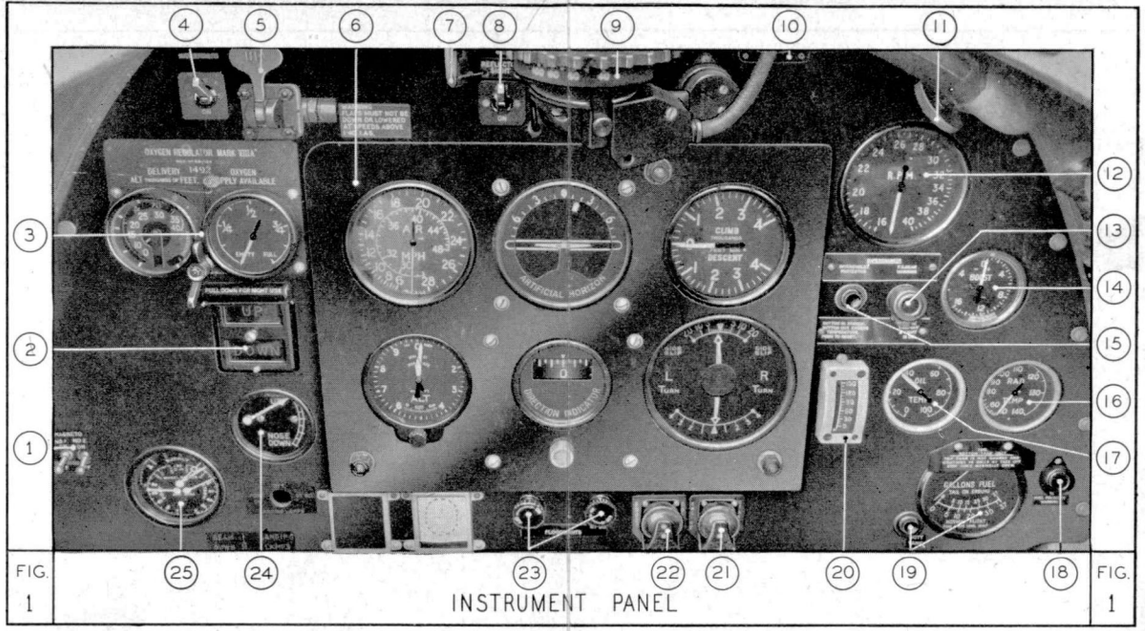


FIG. 1 — INSTRUMENT PANEL — FIG. 1

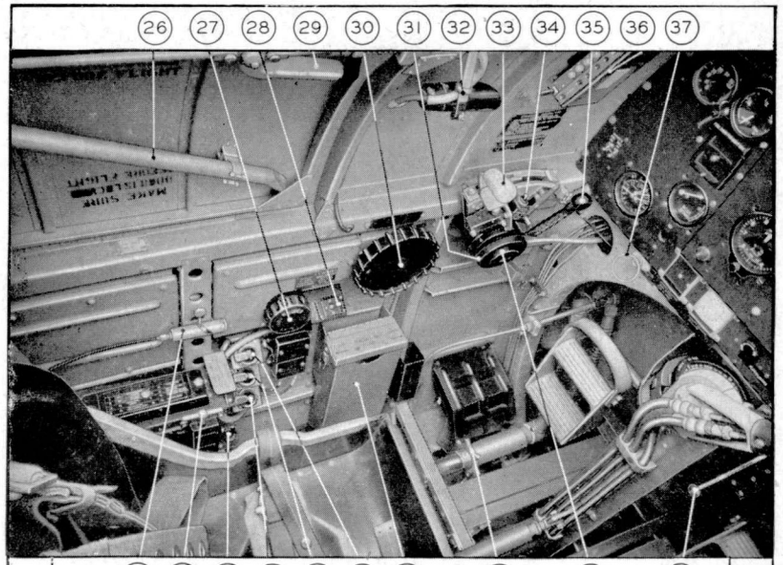


FIG 2 — COCKPIT - PORT SIDE — FIG. 2

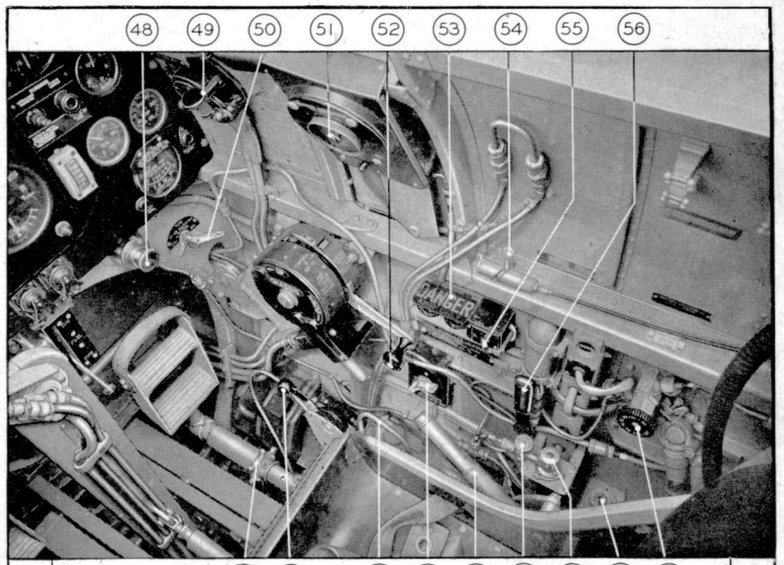
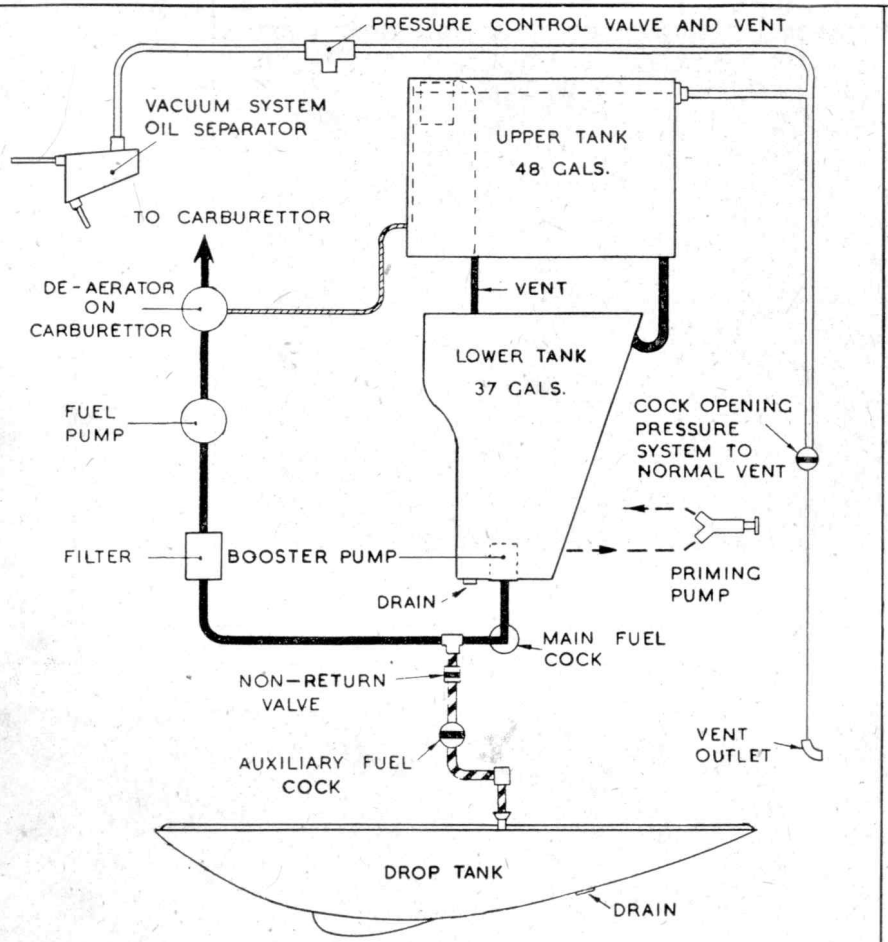


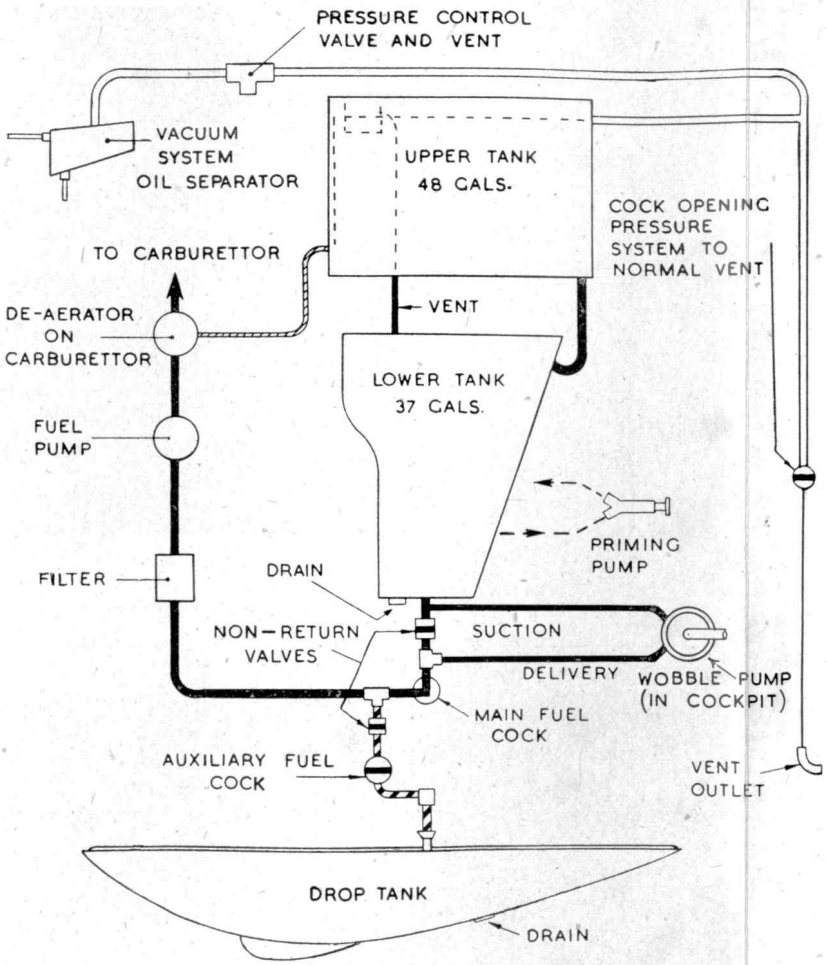
FIG. 3 — COCKPIT - STARBOARD - SIDE — FIG. 3



BOOSTER PUMP INSTALLATION

LATER MERLIN 66 & 70 ENGINES

MAIN FUEL SYSTEM
AUXILIARY SYSTEM
PRIMING SYSTEM
DE-AERATOR SYSTEM
PRESSURE SYSTEM



WOBBLE PUMP INSTALLATION

EARLY MERLIN 66 & 70 ENGINES

MAIN FUEL SYSTEM
AUXILIARY SYSTEM
PRIMING SYSTEM
DE-AERATOR SYSTEM
PRESSURE SYSTEM
WOBBLE PUMP SYSTEM

FIG 4

FUEL SYSTEM DIAGRAM

MERLIN 61 & 63 ENGINES ARE NOT FITTED WITH BOOSTER OR WOBBLE PUMPS

FIG 4

791 Wt. 8028/N545 2,500 8/43 C.P. Ltd. Gp. 784


These are being listed for the
benifit for people interested
in British or Commonwealth
Aircraft
While it did cost me a great
sum of money to aquire
these documents, all I ask in
return is some credit.
~JimSan