

PART II

HANDLING INSTRUCTIONS

6. Management of the fuel system

(i) *Without drop tanks:*

(a) When all tanks are full, the aircraft can be taken off on any combination of tanks, but it is recommended that take-off should be made with all tanks on. The main tank should be turned off when airborne and used as a reserve; otherwise, this tank, having a gravity head, will drain first.

(b) Under no circumstances may the take-off be made on all tanks if any wing tank is less than half full. In this case the take-off must be made on the main tank only with the wing tanks isolated. Change over to the wing tanks when airborne.

(c) For normal flying, it is recommended that both inter-spar tanks and nose tanks be used together; individual tanks should be isolated only if damaged by enemy action. When all fuel has been consumed from the interspar or nose tanks the empty tanks should first be turned off and then main tank turned on. The engine will pick up on the main tank in 3 seconds if this procedure is adopted.

(d) If the main tank has been inadvertently drained first, it is imperative that it should be turned off when empty; otherwise, the engine will not pick up on the interspar or nose tanks.

(e) If at any time the engine should cut through lack of fuel, immediate action should be as follows:—

(a) Close the throttle.

(b) Check fuel contents gauge.

(c) Isolate empty tank or tanks and turn on full tank.

(d) Increase r.p.m. control to max. r.p.m.

(e) Slowly open and close throttle about one-third until engine picks up.

(f) For landing, always turn on the main tank and isolate the wing tanks if they are nearly empty.

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NOTE.—Another important reason why the main tank should be saved as a reserve is that this tank, having a deep sump, will drain completely even in yaw and at steep approach angles without fear of air locking. This is not the case with the shallow wing tanks which have no sumps and are very susceptible to yawing effects.

(ii) *With drop tanks:*

(a) Maximum diving speed must not exceed 450 m.p.h. I.A.S. up to 15,000 feet. Above this height the maximum permissible diving speed is 50 m.p.h. less than the maximum permissible without drop tanks.

(b) Tanks must not be jettisoned at speeds in excess of 400 m.p.h. I.A.S. and only in straight flight. Unless the enemy is engaged, there is little point in jettisoning the tanks when dry, as this will only increase the range by 2 per cent.

(c) Spinning is not permitted.

(d) Start, warm up and take off on the main tanks with drop tanks turned OFF. At a safe height change over to the port drop tank and turn OFF all main tanks. After the port drop tank has been used turn quickly over to the starboard drop tank.

NOTE.—The engine will cut almost immediately after the fuel pressure warning light shows a drop in pressure. When flying at low altitudes, therefore, it is important to change over to the second drop tank or to the main supply tanks, when it is estimated that the drop tank in use is nearly empty and *before* the warning light comes on. The drop tanks may, however, be run dry if at a safe height sufficient to allow the engine to pick up.

(e) Should the engine not pick up after changing from port to starboard drop tank, immediately turn this tank OFF and then turn the main supply tanks ON (*see* also (i) (e) above). After ensuring that the fuel pressure is restored and the engine running satisfactorily, the starboard drop tank should be turned ON again and all the main tanks OFF.

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(f) After the starboard tank has been used, first turn OFF the drop tanks and then turn ON all the main supply tanks. The main tanks should then be used in the normal manner, i.e. the interspar and nose tanks should be used first.

(g) At heights above 10,000 feet when using drop tanks the pressurising valve should be turned ON.

37. Preliminaries

- (i) On entering the cockpit check
 - Undercarriage lever DOWN
 - Undercarriage lever locking catch LOCK
- (ii) Switch on the undercarriage indicator and check that the green lights appear.
- (iii) Cockpit hood locked open.
- (iv) See that the footstep is retracted (operated by closing the top hand grip on the starboard side).

38. Starting engine and warming up

NOTE.—Before starting the engine the aircraft should be faced into wind and if a full run-up is intended the tail must be tied down. Ensure that there are no aircraft or personnel behind.

- (i) Set:
 - Ignition switches .. OFF
 - Fuel All tanks ON (see Para. 36)
 - Flaps Up (selector at VALVE SHUT)
 - Propeller speed control Fully forward
 - Supercharger control .. M (up)
 - Radiator shutter .. DOWN
- (ii) Check that there is not a live cartridge in the firing position, then have the engine turned through three or four revolutions to ensure that it is free.
- (iii) *Starting*.—The pilot must obtain an affirmative visual "all clear" signal before firing each cartridge.

WARNING—There is a possibility of sleeve seizure when starting a cold engine. This will be indicated by the rotation of the propeller becoming less as each cartridge is fired.

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- (a) Set the cut-out lever to START.
(b) Open the throttle gently to the stop.
(c) Prime the carburettor until the fuel pressure warning light goes out. Then screw down the pump.
(d) Load the cartridge starter. The following types of cartridge should be used.

At air temperatures above	+5° C.	No. 2	Mark II
„ „ „ below	+5° C.	No. 3	Mark I

(e) Switch ON the ignition.

(f) Carefully operate the cylinder priming pump until increased resistance is felt, and then prime the cylinders with full vigorous strokes as follows:

Oil temperature	No. of strokes
0° C. to +10° C.	5
+10° C. to +20° C.	4
+20° C. to +30° C.	3

If the engine has been standing less than half an hour, or if over half an hour and the oil temperature is still above + 30° C., prime with one stroke only.

(g) Immediately after priming, press the booster-coil and starter buttons simultaneously. Keep the booster-coil pushbutton depressed and as the engine fires operate the priming pump with short sharp strokes, if and as required, until the engine is running steadily. Stop priming if white smoke issues from the exhaust stubs.

NOTE.—Do not jerk the throttle if the engine fails to pick up, as no useful purpose is served and the air intake will be flooded with fuel, probably leading to a fire.

(h) As soon as the engine is running steadily depress the priming pump slowly, and screw it down. Release the booster-coil pushbutton and return cut-out lever to NORMAL.

(j) If the engine fails to start at the first attempt, it must not be primed again until it fires on a subsequent attempt. Once the engine has fired, prime vigorously until the engine is running steadily.

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NOTE.—If the engine fails to start after three cartridges have been fired, switch off, and blow the engine out and recommence at sub-para. (a). Priming of the engine on starting is limited to 15 full strokes of the priming pump, after which, if the engine fails to start, the cylinders must be primed with oil.

- (iv) *Fire* : If the engine catches fire the following drill must be carried out:
- (a) Ground personnel shout " FIRE ".
 - (b) The pilot must switch OFF the ignition immediately and then extend both arms outside the cockpit to indicate that the engine is safe.
 - (c) When the man with the extinguisher sees that the pilot has his arms extended he must immediately apply the extinguisher to the air intake.
- (v) Run the engine at 1,000 r.p.m. and check that it is functioning normally. Maintain this speed until the oil pressure falls below 100 lb./sq.in.
- (vi) With the oil pressure below 100 lb./sq.in. increase engine speed progressively to 2,000 r.p.m. and test each magneto as a precautionary check.
- (vii) Warm up at 2,000 r.p.m. until the oil temperature reaches 40° C.

39. Testing the engine and installations

NOTE.—It is important that the engine be allowed to warm up properly before being opened up for ground checks. The engine should normally not be opened up before the oil temperature has reached a minimum of 40° C.

While warming up

- (i) Make the usual checks of temperatures, pressures and controls.
- (ii) Check pneumatic pressure (normal supply 450 lb./sq.in.). If the pressure is low, ensure that the pump is definitely building up pressure, if not, the aircraft should not be flown.

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- (iii) Check hydraulic system by lowering and raising flaps; ensure that selector is returned to VALVE SHUT.

After warming up

NOTE.—The following comprehensive checks should be carried out after repair, inspection (other than daily), or at the pilot's discretion, and the tail *must* be tied down. Normally they may be reduced in accordance with local instructions, and the tail need not be tied down if r.p.m. do not exceed 2,800.

- (iv) Open up to zero boost and check operation of the two-speed supercharger once only. R.p.m. should fall when S ratio is engaged.
- (v) Exercise and check operation of propeller speed control at least twice, as follows :
- (a) Set control fully forward and close throttle to obtain 2,400 r.p.m.
- (b) Set control back to the positive coarse pitch position.
- (c) When the r.p.m. have dropped to $1,600 \pm 50$ move the control to the fully forward position. R.p.m. should rise to 2,400 r.p.m.
- (vi) With the propeller control fully forward open the throttle lever fully and check take-off boost and static r.p.m.
- (vii) Throttle back to maximum rich continuous boost and test each magneto in turn. The drop in r.p.m. should not exceed 50.

40. Taxying

The brakes are powerful and should be used with care.

41. Check list for take-off

- (i) T — Trimming tabs .. Elevator: $1\frac{1}{2}$ divs. nose down
Rudder: full port
- P — Propeller Fully forward
- F — Fuel Check cock settings (*see* Para. 36)
- F — Flaps Up (lever at VALVE SHUT)
- Supercharger .. M ratio
- Radiator shutter DOWN
- (ii) Open up the engine to 2,500 r.p.m. to clear it and then if necessary wipe the oil off the outside of the windscreen.

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42. Take-off

- (i) Full throttle may be used for take-off, but there is little reduction in take-off run if more than +4 lb./sq.in. boost is used.
- (ii) The take-off run is reduced by approximately 100 yards by using between 20° and 30° of flap, although when using flap for take-off there is a greater tendency to swing to the right.
- (iii) Retract the undercarriage as early as possible after take-off. Should the undercarriage red lights fail to go out, throttle back and reduce speed to about 145-150 m.p.h. when the deceleration will allow the wheels to lock UP. If flaps are used for take-off they should be raised at a safe height (200 feet). The undercarriage red lights may fail to go out until the flaps are fully up.

43. Climbing

- (i) The recommended speed for climb is 185 m.p.h. I.A.S. up to 20,000 feet.
- (ii) For maximum rate of climb at climbing power, change to S ratio when boost has dropped by 3 lb./sq.in. (about 10,000 feet).

44. General flying

- (i) *Stability.*—The aircraft is stable directionally and laterally, but is slightly unstable longitudinally.
- (ii) *Controls.*—The aileron control remains effective up to the maximum permissible speed, but is sluggish at low speeds. The rudder should be used firmly for going into a turn or when reversing a turn. The elevator is light and effective, but with flaps and undercarriage down response becomes rather sluggish.
- (iii) *Change of trim*

Flaps DOWN	Nose down
Undercarriage DOWN	Nose down
Radiator shutter UP	Slightly nose down

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Directional trim changes with variation in airspeed and throttle setting, and full use should be made of the rudder trimming tab to avoid flying with sideslip. This tab, however, is very sensitive and should, therefore, be used gently. Fore and aft trim is affected by changes in directional trim: left yaw produces a tendency for the nose to drop, and right yaw for the nose to rise.

- (iv) *Flying at reduced speed.*—Reduce speed to 200 m.p.h. I.A.S. and lower flaps 20°. Set the propeller speed control to 3,150 r.p.m. and fly at about 170 m.p.h. I.A.S.

45. Stalling

Stalling speeds at 11,500 lb. are:

Flaps and undercarriage up	85 m.p.h. I.A.S.
" " " down	75 m.p.h. I.A.S.

- (i) There is no warning of the stall at which the left wing drops sharply.
- (ii) *High speed stall.*—If excessive "g" is applied in a turn or recovery from a dive, the ailerons "snatch" and experience shows that either wing may drop: with further backward movement of the control column the aircraft will become inverted and finally spin. The aircraft responds immediately if recovery action is initiated when aileron "snatch" occurs.

46. Spinning

Spinning is *not permitted* pending results of spinning trials. Recovery from inadvertent spins to be in accordance with A.P. 129 Flying Training Manual, Chapter III, paras. 197-205.

47. Diving

- (i) Before diving make certain that the radiator shutter is UP. A strong nose-down pitch results from closing the shutter in a dive.

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- (ii) If a dive is to be continued below 10,000 feet, select M ratio before commencing the dive. The throttle should not be fully closed.
- (iii) In the dive the aircraft tends to become tail heavy but no retrimming is necessary. The elevator trimming tabs are very sensitive and should therefore not be used when diving.
- (iv) As speed increases the aircraft tends to yaw to port. This should be corrected by use of the rudder trimming tab, but as this control is sensitive, it must be used slowly and gently.

48. Aerobatics

All the normal aerobatics are easy to perform, but a large amount of height may be gained or lost during some manœuvres and an ample margin must be allowed. Particular care should be taken diving out from a half-roll. Such a manœuvre should not be attempted below 10,000 feet if the speed is above 250 m.p.h. I.A.S. at the commencement.

Looping.—Use maximum climbing power and start the loop at a speed of at least 380 m.p.h. I.A.S. Care must be taken to avoid any harsh backward movement of the control column as this may induce a high speed stall.

Rolling.—Speed should be at least 250 m.p.h. I.A.S. and the roll sufficiently “barrelled” to keep the engine running and avoid any risk of loss of oil pressure.

Half roll off loop.—Maximum climbing power should be used and the speed should be not less than 400 m.p.h. I.A.S. when starting the loop.

Upward roll.—Maximum climbing power should be used and the speed at the bottom of the dive should be

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about 400 m.p.h. I.A.S. for a fairly steep climbing roll, and 450 m.p.h. I.A.S. or more for a vertically upward roll.

Flick manoeuvres are not permitted.

49. Check list for landing

- (i) Turn on main tank, isolate wing tanks if nearly empty.
- (ii) Reduce speed to 200 m.p.h. I.A.S. and check brake pressure.
 - U ---Undercarriage .. DOWN (check wing indicators and green lights, and warning light).
 - P —Propeller control .. Fully forward.
 - Supercharger .. M ratio
 - Flaps Fully down (and lever to VALVE SHUT)
 - Radiator shutter .. DOWN (UP if temp. low)
- (iii) A tendency to yaw and pitch is noticeable as the undercarriage comes down.
- (iv) The flaps are large and the rate of descent with them lowered is consequently rapid.

50. Approach and landing

Approach speeds in m.p.h. I.A.S. are as follows:

			(Flaps up)
Engine assisted	100	120	
Glide	120	130	

NOTE.—Do not turn at speeds below 130–140 m.p.h. I.A.S.

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51. Beam approach

	Preliminary Approach	Inner Marker on Q.D.R.	Outer Marker on Q.D.M.	Inner Marker on Q.D.M.
Indicated height (feet)	1,500	1,000	700-800	150
Action	Lower 20° flap	Lower undercarriage and radiator flap	Lower full flap	Throttle back slowly
Resultant change of trim	Nose down	Slight nose down	Slight nose down	Slight nose down
I.A.S. m.p.h.	170	160-170	120	110-115
R.p.m.	3,150	3,150	3,500	3,500
Boost (level flight)	- 4	- 2	- ½	-
Boost (- 500 ft./min.)	- 4½ approx.	- 3	- 3	-
Boost (overshoot)	-	-	-	+ 6
Remarks	Reduce speed to below 200 I.A.S. before lowering 20° flap—retrim rudder		OVERSHOOT Retrim. Undercarriage up. Flaps up in stages at 400 ft. Nose up change of trim and swing to right	
Altimeter error at take-off minus 50 feet Altimeter error at touch-down minus 90 feet Add 3.2 millibars to Q.F.E. to give zero reading at touch-down.				

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52. Mislanding

- (i) The aircraft will climb away easily with undercarriage and flaps down, and the use of full take-off boost is unnecessary.
- (ii) Open the throttle slowly to about +4 lb./sq.in. boost and counteract the tendency to swing right by firm use of the rudder.
- (iii) Before the undercarriage is raised, the flaps selector must be at the VALVE SHUT position, otherwise the undercarriage will not retract fully.
- (iv) Climb at 140-150 m.p.h. I.A.S. and raise the flaps in stages at about 200 feet. The flaps come up slowly.

53. After landing

- (i) Before taxiing raise the flaps and set radiator shutter DOWN (if landing has been made with radiator shutter UP).
- (ii) Change to S ratio once and back to M ratio.
- (iii) To stop the engine, open up to 1,000 r.p.m. until blue smoke ceases to issue from the exhaust stubs, indicating that surplus oil has been expelled. Operate the CUT-OUT lever with the throttle set at the 1,000 r.p.m. position
- (iv) When the engine has stopped, switch OFF the ignition and turn off fuel: return cut-out lever to NORMAL.

NOTE.—Starter cartridges should be removed overnight to avoid deterioration.